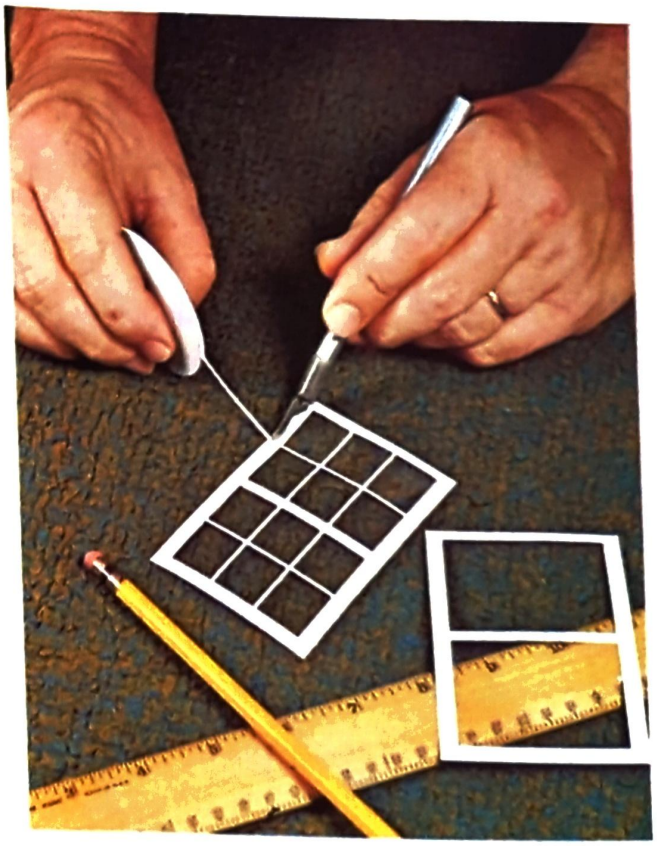
POPULAR MECHANICS

do-it-yourself

ENCYCLOPEDIA



DOLLHOUSES have been loved by little girls since great-grandmother's day, but on page 790 you'll find an idea to double dollhouse popularity. What's the idea? Just make the dollhouse a miniature version of your own home. The story tells you how to duplicate siding, roofing, brick walls and windows in miniature

THE FENCE around your world can take many shapes including this attractive redwood design. The story on fences, page 950, offers you a number of design ideas and some very practical hints on how to build your fence to stay straight and true

Photo courtesy California Redwood Association

DOES THIS LOOK like a basement? It is. Read how you, too can remodel with drywall, on page 842

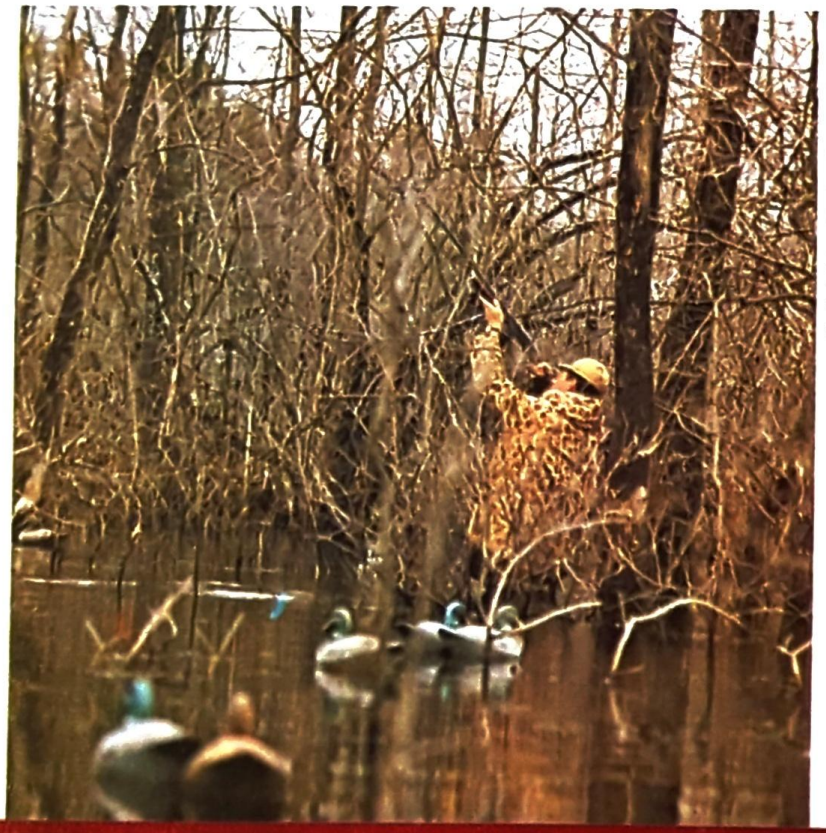
Photo courtesy Marlite Wallpanels

DORMERS OFTEN CAN ADD an entire second floor of usable space to a home. See page 801

THIS WAS AN OLD WALL with cracked plaster before it was remodeled with drywall. See page 842

Photo courtesy National Gypsum Company

DEER HUNTERS will find a novel tip on how to bag prize trophies like this one on page 778



THE DUCK HUNTER who comes home with his limit every time knows how to use his decoys. There's an art to making them, and an art to placing them. On page 773 you'll find some good tips on decoys that will increase your take the coming season

›pular Mechanics
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in 16 volumes

A complete guide to

- home maintenance
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- power-tool know-how
- hobbies
- automotive upkeep
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- fishing
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- model making
- outdoor living
- radio, TV and electronics

Volume 5

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VOLUME 5

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How to use your Encyclopedia

Browse. Glance through this volume, or any other volume of the Encyclopedia. Likely you will find the solution to a particular home-maintenance problem that has been bothering you, or a shop project so appealing that you will immediately head for your bench. Browsing not only is enjoyable, but is a source of ideas.

Seek specific information. Perhaps you want to find out how to cure that leak in your basement, how to keep the exterior paint from peeling, or how to tune and set the carburetor on your car.

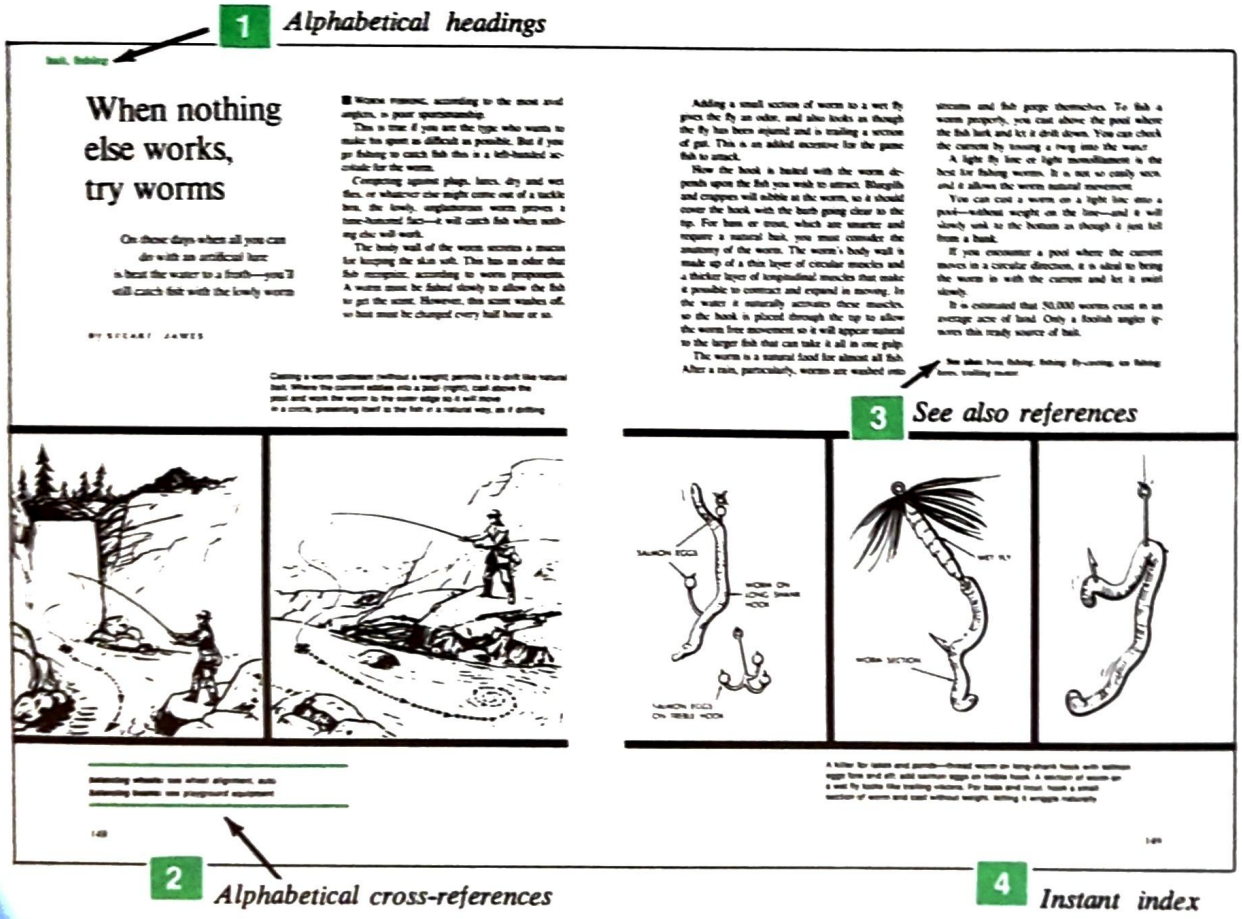
Four reader aids, all cross-referenced, will enable you to find specific information:

1. *Alphabetical headings.* Located at the top of the page, these headings cover broad classifications of information. If you are looking for information on how to keep paint from peeling, for example, look up "Paints" alphabetically, then find the particular section dealing with peeling paint.

2. *Alphabetical cross-references.* These are shown in a box at the bottom of the page. Some material can logically be classified under more than one alphabetical heading, so if you don't find what you are seeking alphabetically (as described above), be sure to check the *alphabetical cross-references* at the bottom of the page; there you may find precisely the classification you are seeking. For example, you and your son decide to build a model airplane, and are looking for plans. You look up "Model airplanes" and find nothing under that alphabetical heading. However, if you glance at the bottom *of that same page* you will find an alphabetical cross-reference that reads: **model airplanes,** see airplane models.

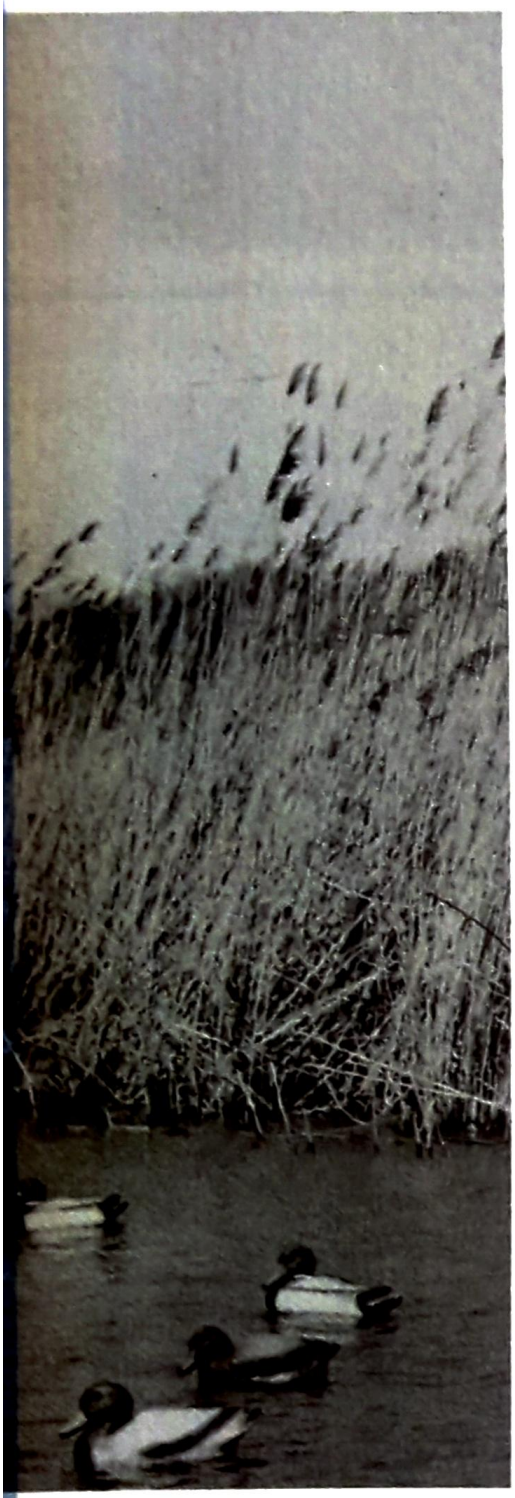
3. *See also references.* These are shown at the end of many articles. They refer you to related articles which may also be of interest.

4. *Instant index.* Located at the end of Volume 16, it is thoroughly cross-referenced to help you find information under any heading.



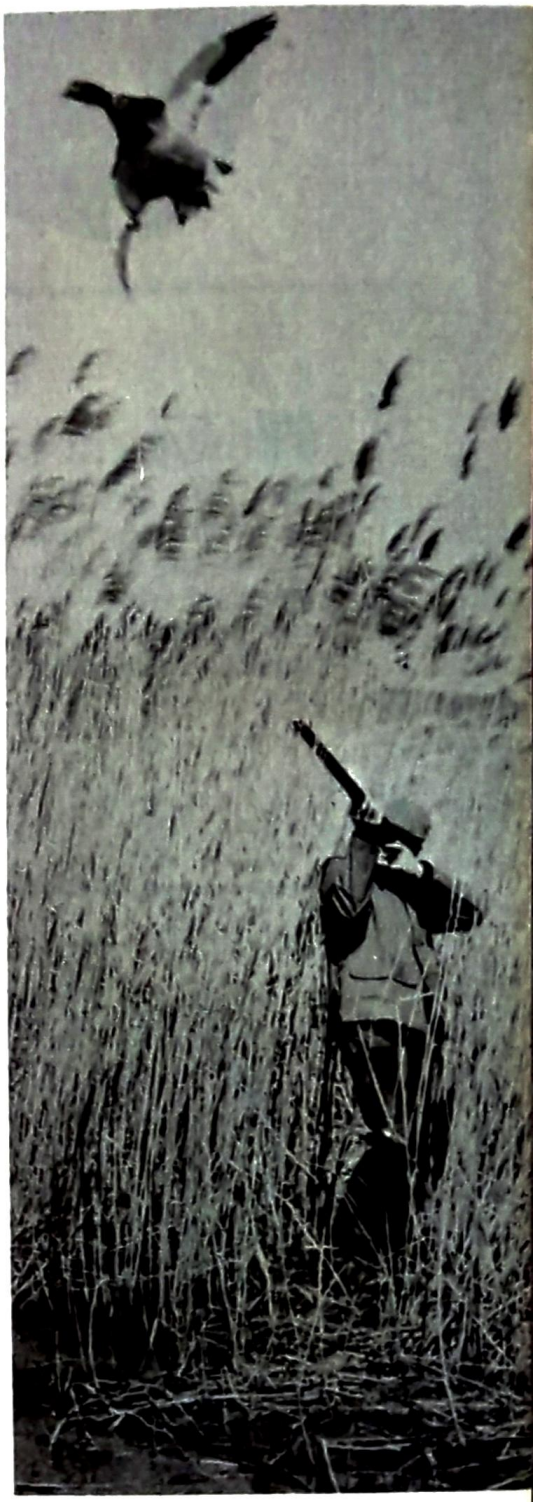
Tips on decoys

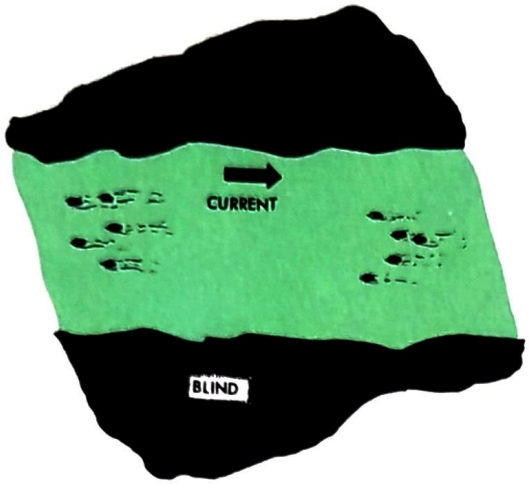
BY WILLIAM W. HUNTER



There's more to luring ducks into gun range than simply setting out some decoys. If you pay attention to small details, you can change an ordinary bunch of decoys into an inviting spread that will pull ducks in for you consistently. . . .

turn page



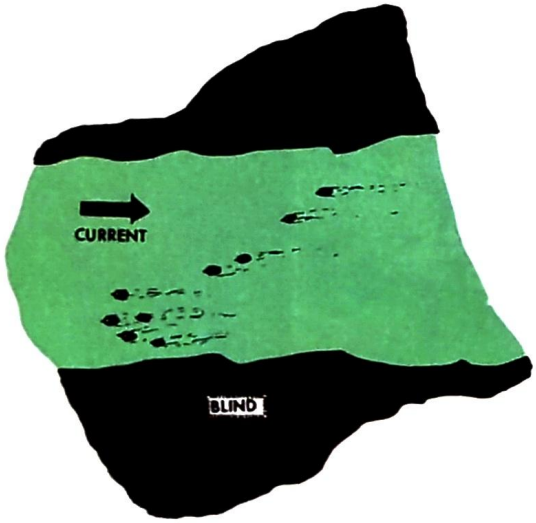


1 the split-spread trick

In shooting over moving water, you can bring decoying ducks in where you want them by splitting them into two groups with a space between them. The newcomers will usually drop into the open space, right in front of your blind.

2 the extra wing gambit

Real ducks don't always look like stiff, painted decoys—they stretch and ruffle their feathers like chickens. Save the wings from a few ducks and attach them to some of your decoys with rubber bands as shown; they simulate a resting duck stretching its wings and will help give your spread some realism.

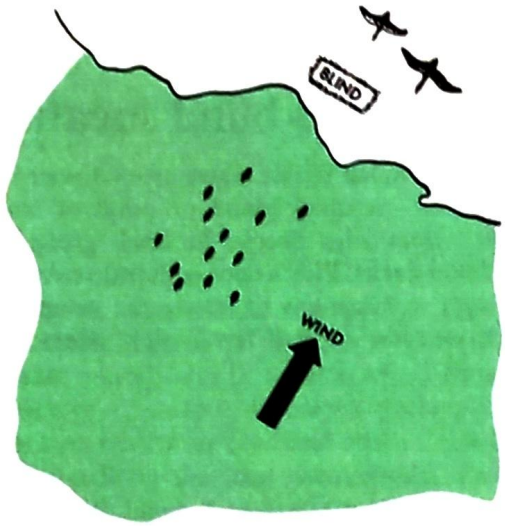


3 the fall-in-line trick

Ducks follow each other like sheep sometimes. A line of decoys set up to look like a flock of newcomers joining the main flock will allay the fears of wary flights and make your spread easier for low-flying ducks to see.

4 the rippling decoy ploy

Nothing looks phonier than a spread of motionless decoys on glassy-smooth water. Anything you can do to add some motion will make the decoys look more lifelike. One good trick, on moving water, is to set up rocks upstream from your decoys to make an eddy in the current. It will provide the blocks with constant motion.



5 hiding in the wind

Since ducks almost invariably land into the wind and keep their eyes on their landing spot during their approach run, you can hide best downwind from your decoys. The approaching duck's view will slide over the blind to focus on the spread. Also, when you stand to shoot, the ducks must then fly upward to escape.

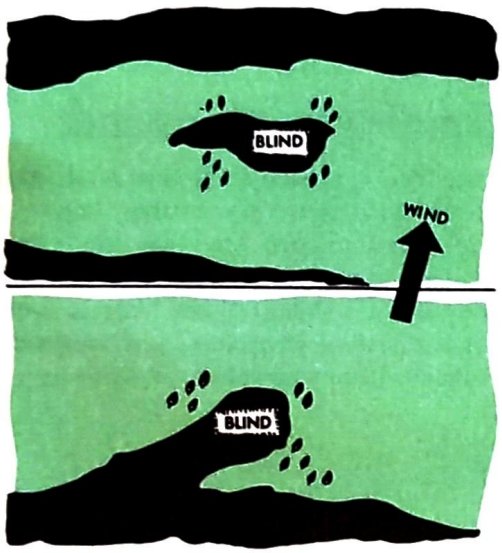
6 the fake snow sign

Smart ducks, looking over decoys set out in fresh snow in a field, look for signs of their feeding. You can simulate this by stamping down the snow in the area around your decoys until the area looks like a popular feeding spot. Be careful, though, not to leave telltale muddy footprints—just pack down the snow.

decoy tips, continued

7 three field-shooting tricks

Remember when shooting over a dry-land spread: Always face the decoys into the wind, just as on water. Never place one decoy in line behind another—the real ducks always feed on their own path parallel to the others. Always tip the decoys' chests upward somewhat, to make the spread more easily visible from above.



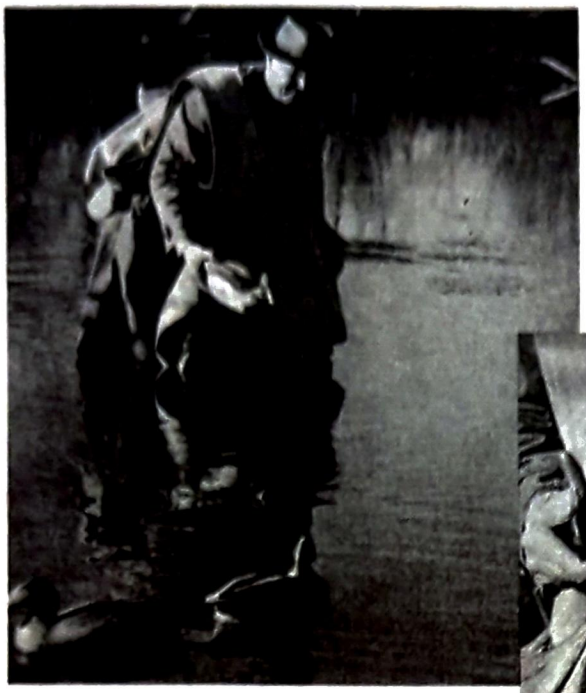
8 the ideal blind location

Have as much visible water around your blind as possible—a small island or point of land is perfect. Spot your decoys in small groups like contented ducks. Pick a spot with little cover, and use only a minimum of cover for your blind. Ducks are less wary if few hiding places show.

9 the high-ground trick

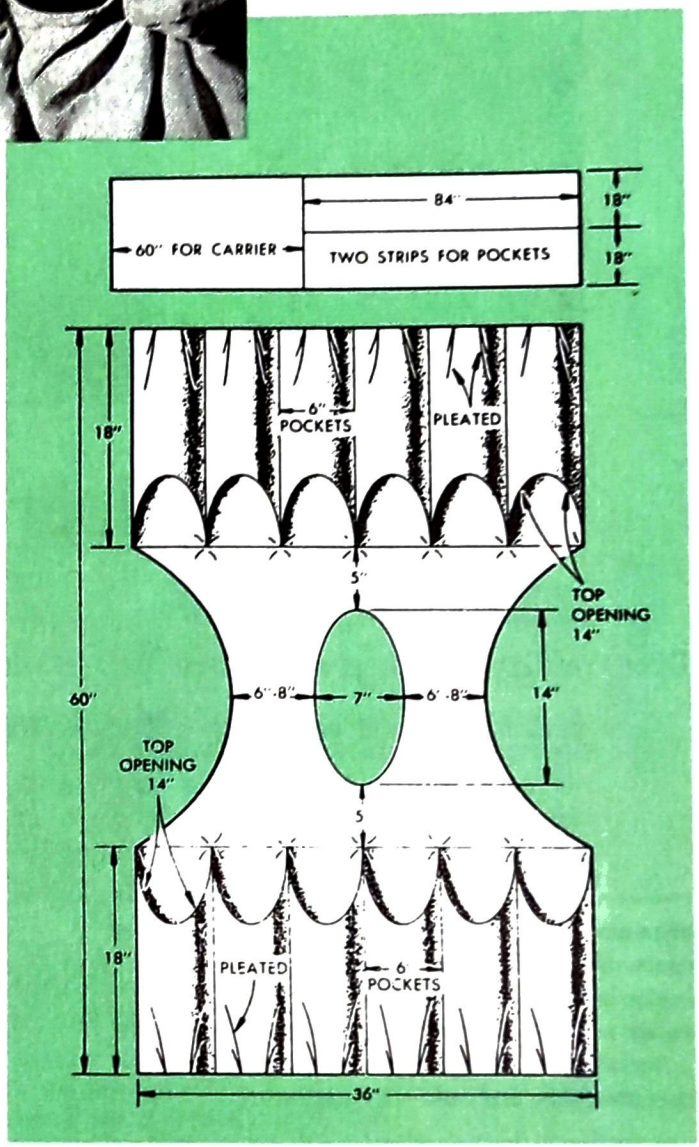
Smart ducks like to feed on high ground so they can spot approaching danger. A flight of ducks won't join your decoys if they think they're feeding in a dangerous low spot. If visibility permits, place your blind in that low ground—tall cover will look more natural in low spots.

See also: ammunition; boots; deer hunting; duck blind; marksmanship; pheasant hunting; shotguns; tents.



Tote coat for decoys

By WILLIAM W. HUNTER



If you've ever missed that perfect shot at puddle ducks because of the sack of decoys on your back, you'll go for this canvas tote. Just load your rack of 12 decoys, 6 to each pocket, drop the tote coat over your head and shake it down a little to distribute the load comfortably. You'll still have both hands free to put a scattergun on any duck that gets up unexpectedly from a small backwater or spring hole while you're on the way to the blind, or when you're shooting a river or ditch from the banks. It's a fine way to tote decoys.

When you finally do get to the blind, drop off the rack of decoys, lift the tote over your head, fold it and you have a reasonably comfortable cushion to sit on for the long wait. The tote requires about 4½ yds. of medium-weight canvas. Cut it into three strips as in the upper detail, then cut an oval opening in the carrier piece and cut to the shape indicated in the lower detail to fit over your shoulders. Hem the edges and sew on the pockets, six at each end. Note that each pocket is pleated at the bottom and has a 14-in. opening at the top. Bar-tack each pocket at the top and bottom corners so the coat will take rough usage without tearing.

Rattle up a deer this year

BY PETE CZURA

Deer "rattling" is almost a forgotten art, but with a pair of antlers and a little practice anyone can bring a buck on the run

delta-wing models: see glider model; jet plane model
dents, removing: see auto repair
design drilling: see drilling
desks: see bedroom furniture; children's furniture; remodeling; step table; weekend projects
detectors, light and water: see electronics

THE ART OF CALLING DEER is as ancient as deer hunting but only a handful of sportsmen know about the "rattling" technique, which can be one of the most productive systems to bag your deer.

To become a "rattling" deer hunter is simple. Take a pair of deer antlers, cut them apart, and when you are afield just slam them together to make it sound like a pair of bucks battling.

Bucks hearing this commotion will come lickety-split toward the sound of the antlers being banged with the idea of whipping the winner and acquiring another doe.

Battles among bucks are common, especially during the breeding period—the rut—which usually begins with the first chilly nip in the fall. Ruts generally last 6 weeks but have lasted as long as 8 to 10 weeks.

Pick a set of heavy-beamed antlers for your rattling. The sounds of such a pair being banged together will carry the greatest distance. After you have picked a likely spot to hunt, pound the antlers together, twist them back and forth a few times, then slam them together again. Feisty bucks don't back off and keep crashing at each other when battling. After their initial fierce clash, live bucks then rake their antlers back and forth, heads lowered, struggling to obtain a good position in order to render a crippling blow.

Choosing the right kind of rattling antlers can be important. Successful deer "rattlers" have found that mule deer racks are better for this kind of work than white-tailed antlers, because the muley racks are straighter, whereas the white-tails have inward curve, and these make it tough to slam them together properly to imitate a buck battle.

To prepare "rattling" antlers, saw them off at their base on the deer's head and then let them season—dry out. A set over a year old will most likely have a phony ring. And to make your chore of toting your rattlers easy, when heading afield, tie your two "rattlers" together with a cord and sling them over shoulder for easy transportation.

Russ Tinsley, author of *Hunting the Whitetail Deer,* says, "Contrary to popular belief, antlers should not be rattled together with the tine points facing each other, as they appear on the deer's head. Rather, the points go in the same direction, with the curve of one antler banged against the curve of the other."

use heavy antlers

"Avoid using a set of light 'rattling antlers,' " Tinsley recommends. "They will more likely bring in only small bucks. For mean, belligerent, big bucks, use heavy antlers and whack them together slowly, but with great force."

When rattling up your deer it's important to remember that if you want to score you must get your quarry to hear your rattling. The sound of your imaginary buck fight won't carry over 400 yards most of the time. This means you must pick a spot where you know big bucks hang about. A still, clear, cold morning is the best time to make your rattling calls carry.

"Deer react to rattling in different ways," says Tinsley. "An eager one might plow right in on you, with blood in his eye. A more wary one might sneak around, looking and listening, reluctant to come closer. Often, in this case, a hunter should beat the antlers on the ground and slam the brush, to give the impression of a heated fight. The idea is to work on the buck's emotions until he can't stand it any longer."

Rattling your trophy buck within gunshot range works best when the open season on deer corresponds to the rut and a high ratio of bucks exist in the area you plan to hunt. In the western part of the country, where many trophy bucks are taken annually, "rattling" is becoming more popular among sportsmen since dense brush prohibits hunting deer by any other method. But it can be just as productive in the woods of the East.

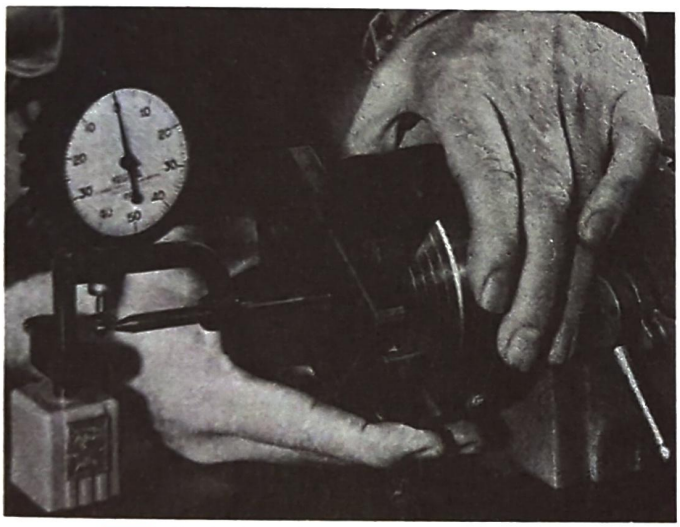
See also: ammunition; boots; marksmanship; pheasant hunting; shotguns; targets; tents.

The ideal method for rattling is simply to make certain that the points of the antlers are in the same direction when being banged together to simulate contact. After you hit them together be sure to twist them back and forth

Fine accuracy with a dial indicator

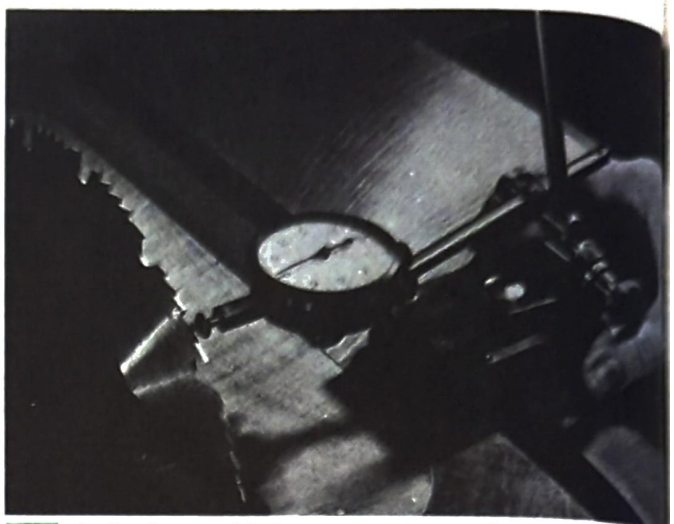
BY MANLY BANISTER

Fine accuracy checks are as easy as telling time with a watch when you have a dial indicator. Use it to check setups, position work, and determine runout



1 Centering a hole for a reaming operation takes the minimum of time when you use a dial indicator, which is read at a glance

diatomite filters: see filters, swimming pool
diameter gauge: see thickness gauge

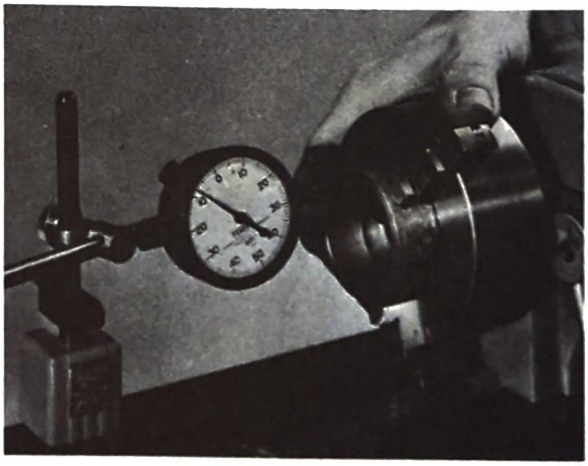


2 A circular saw blade must run true or the kerf will be too wide. The dial indicator can be used to detect the slightest deflection

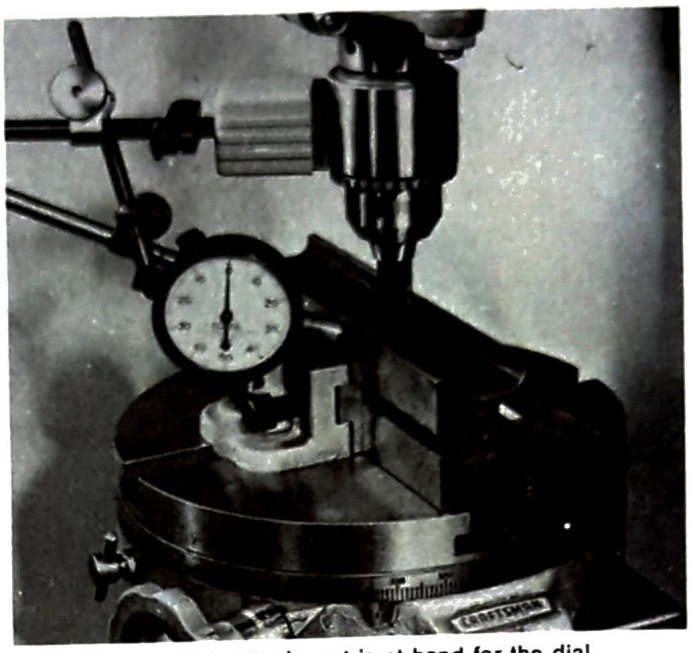
WHEN THE JOB calls for accuracy measured in thousandths of an inch, a dial indicator can give you the correct reading at a glance. Most useful in small shops is the instrument having a movable dial and known as the universal type which gives a plus reading to the right of zero on the dial scale and a minus reading to the left of zero, with a capacity of about 0.3 in. On such an instrument one revolution of the needle usually indicates 0.10-in. movement of the contact button.

A complete instrument set should include the dial and several accessories which increase the range of its usefulness. There should be a toolpost bar and mounting rods to carry the dial, also

3 When you use a dial indicator to locate a workpiece in either a 3 or 4-jaw chuck, you can always be sure that it will be mounted dead true

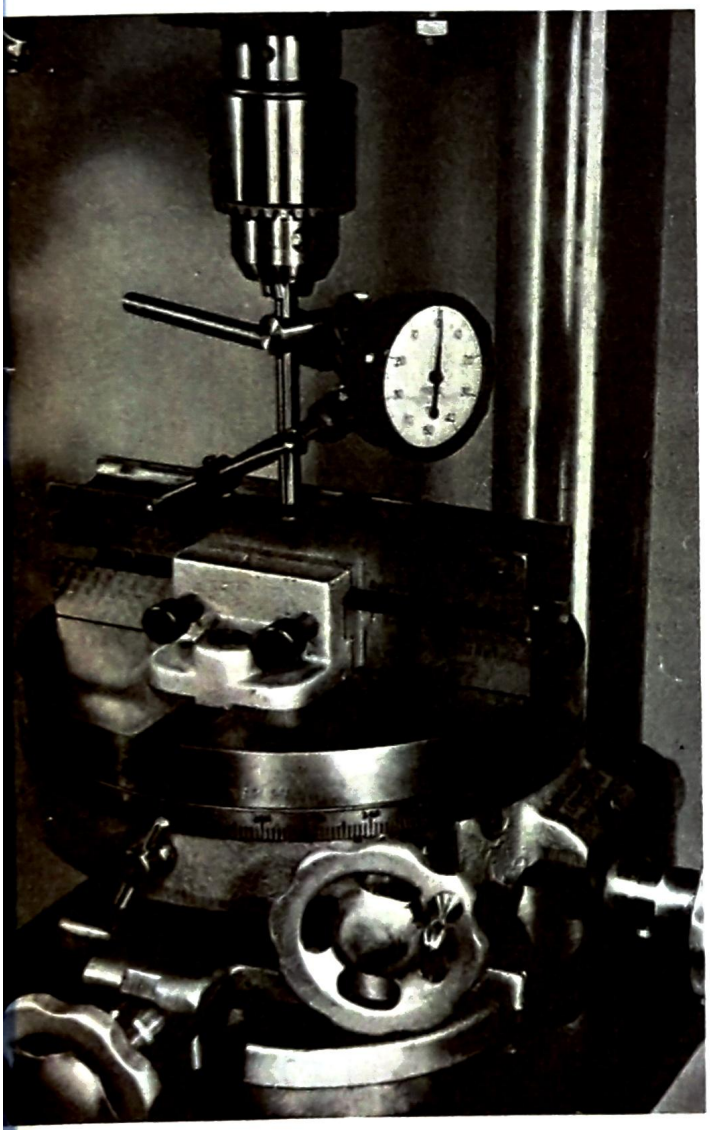


4 Faceplates need checking occasionally for runout, especially the large faceplate on which work is mounted. Indicator is used for the check



5 When no hole attachment is at hand for the dial indicator, the setup for aligning a drill-press milling table is made as shown above

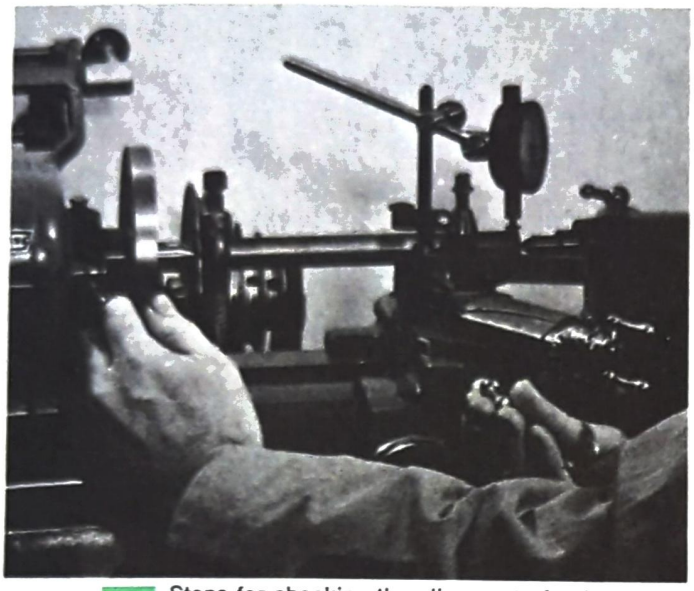
6 A setup for aligning a drill-press milling table can be made with a hole attachment. With or without attachment, drill spindle must be locked



a clamp or a base containing a permanent magnet so that the instrument can be placed at any point on machine or work where measurements are to be taken or a workpiece accurately located. The dial also can be mounted on a surface gauge for operations on a surface plate, for checking runout as in Fig. 2 or a dimension check on a finished part as in Fig. 8. The magnetic base is of special value to modelmakers and others who use small machines for fine work. Here placing the instrument in its proper relationship to machine and work can prove to be quite a problem with only a dial clamp to work with. But the magnetic base holds with a 50-lb. constant pull on any ferrous metal surface, and this assures stability. Even when placed on a painted metal surface that is fairly smooth it will hold.

Figs. 1, 3 and 4, also Figs. 7, and 9 through 13 show a dial indicator in use on a lathe, both for checking the work and the lathe itself for accuracy. Figs. 1 and 3 are typical setup checks. In Fig. 1 an indicator with a hole attachment is being used to center a hole for a reaming operation. Any eccentricity shows on the dial in thousandths of an inch. In Fig. 3 the workpiece is being squared in a 3-jaw chuck, the dial being zeroed against the workpiece. Using the indicator in this way it is possible to position work so that it runs dead true. In Fig. 4 the operator is checking a faceplate for runout. In all three checks the indicator is held by a magnetic base.

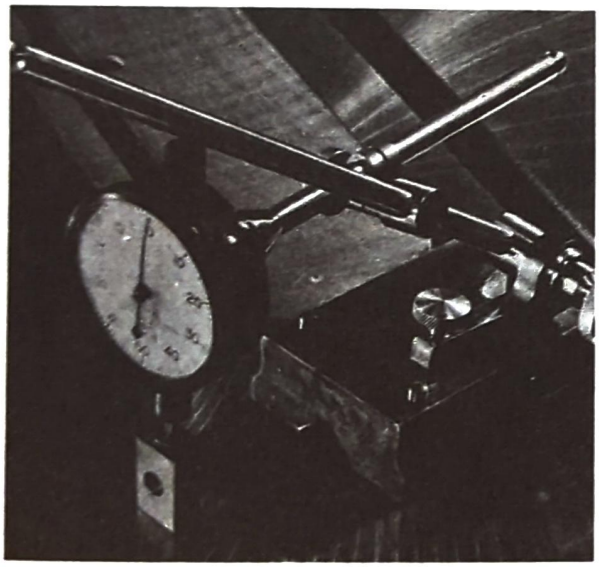
Figs. 7, 9, 10 and 12 picture steps in aligning



7 Steps for checking the alignment of lathe centers are described in the text. This is the first step. Indicator is placed on the lathe carriage

9 The dial is adjusted to a zero reading at the tailstock end of a test mandrel on which a light cut has been made for about 6 in.

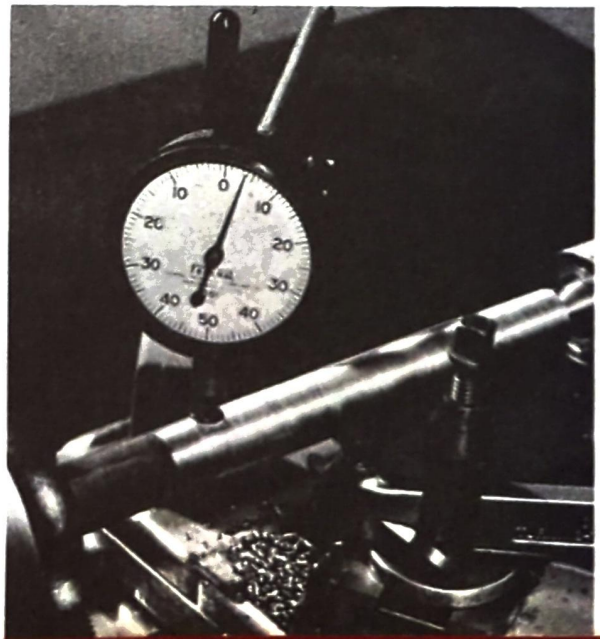
fine accuracy with a dial indicator, continued



8 The dial indicator is mounted on a surface gauge for comparative dimension checks on duplicate workpieces and finished parts

the lathe tailstock with the headstock. Figs. 7 and 9 show the first operation with the dial adjusted to a zero reading at the tailstock end of a test mandrel on which a light cut has been made for a distance of about 6 in. Note that this measurement is not dialed from the tool-post side, or working side of the lathe. Next, measure 6 in. from the end of the test piece, move the carriage to that position and take another reading, Fig. 10. If the reading is on the plus side of the dial scale, the lathe is cutting a slight taper toward the tailstock. If the reading is minus, a taper is being cut with the small end toward the headstock.

10 In the third step in the alignment of lathe centers, the carriage with the indicator is moved to the left to determine the degree of taper



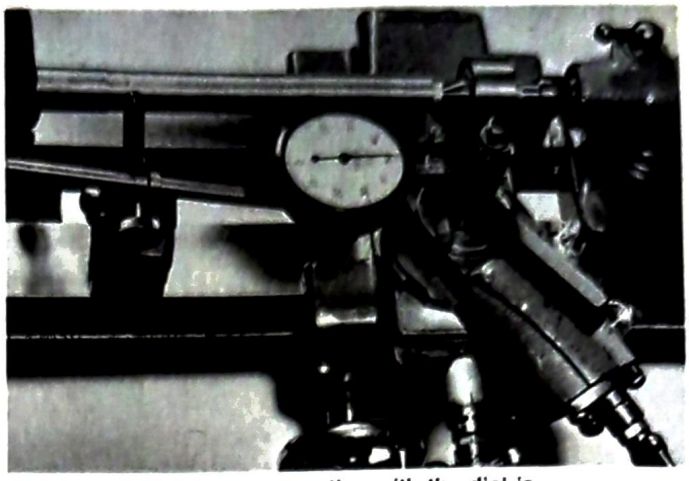
Divide the dial reading by the distance between the two check points (6 in.) to get the amount of taper in thousandths. Multiply this value by the number of inches, that is, by 6. The result is the amount of setover required to bring the lathe centers in exact alignment.

Fig. 12 shows the final setup for aligning the centers. Note that the dial is zeroed at the tailstock end of the work and that it is mounted on the tool post by fixing the magnetic base to the tool-post bar. Then the tailstock is moved forward or back until the needle registers the amount of set-over calculated. When the tailstock has been moved over the required distance and locked at this point, the centers should be precisely in line.

Another important operation with the indicator is setting off a shoulder where the length of the cut must be right on the nose. Fig. 11 pictures the setup with the magnetic base of the indicator fixed on the flat way of the lathe. The indicator button bears against the tool post as pictured.

The squareness check shown in Fig. 13 is similar in purpose to that in Fig. 3, except that here the cross-feed is run in and out in order to move the indicator contact button along the surface of the cylindrical workpiece.

Figs. 5 and 6 picture two ways of aligning the rotary table of a drill-press milling accessory so that work can be mounted and accurately traversed under the spindle. If you do not have the ball-point hole attachment for your indicator, you can lock the drill-press spindle and make a setup with the indicator button bearing against



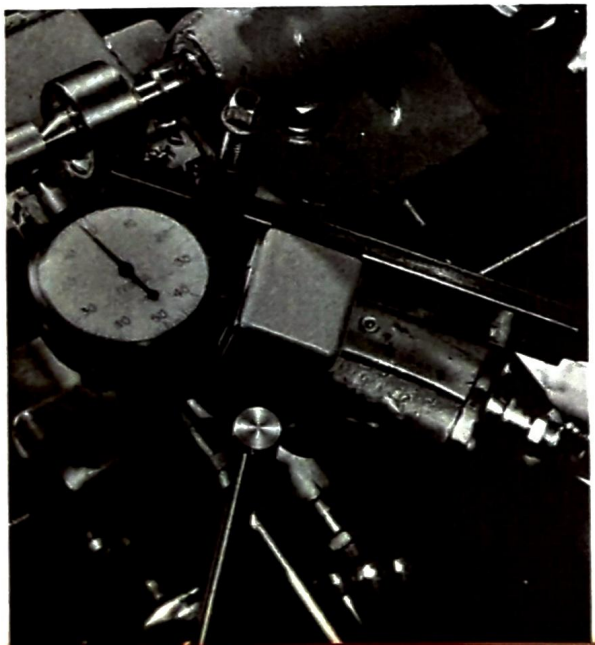
11 Another important operation with the dial is setting off a shoulder where the length of the cut must be on the nose. It's done as shown above

parallels as in Fig. 5. On the other hand, if you have the hole attachment for the dial, then make the setup as in Fig. 6. Although the first method can be considered accurate enough for all but the finest work, the latter method is always to be preferred.

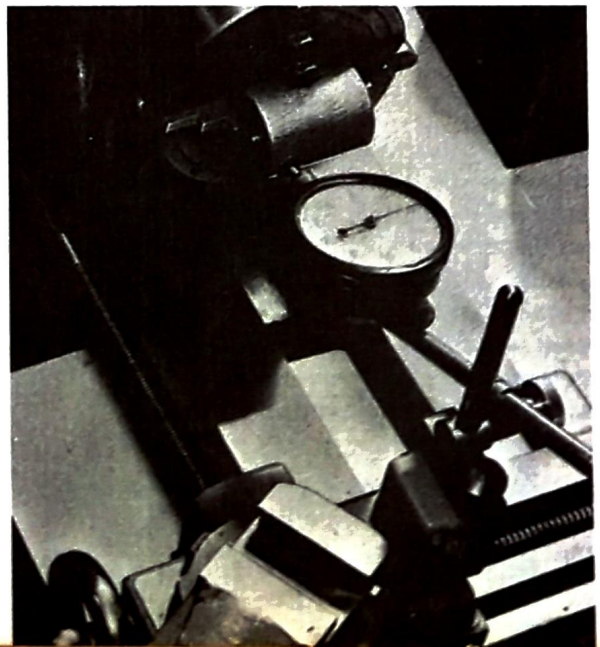
When you use a dial indicator take every precaution to avoid dropping the instrument on the shop floor or even onto the lathe bench top. Such a shock can seriously damage the indicator unit and cause it to register inaccurately. Much the same precautions should be taken with the accessories. Tiny nicks, scratches or dents also can cause inaccurate readings and a costly waste of near-finished parts. Coat accessory parts with light oil to prevent rust.

See also: inlaying; keyways; lathe accessories; lathe techniques; tapers, lathe; thread cutting; tool-post grinder; tool tray, lathe.

12 This photo shows the final step in the alignment of lathe centers. See Figs. 7, 9 and 10. Here the indicator is mounted on the tool-post bar



13 In a squareness check, the cross-feed slide, with the indicator mounted on it, is run in and out to get a deflection reading



Dictate to your tape recorder

BY CLINT MCGIRR

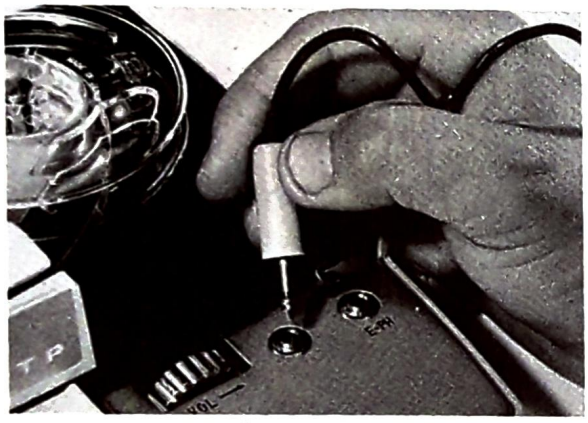
ANY OF THE LOW-PRICED, transistorized tape recorders now on the market can be converted easily into a compact dictating machine. With a few inexpensive electrical items and an hour's time, you can add a foot switch and increase the recorder's versatility many times over.

Once you add the switch you can turn the recorder on or off with a touch of your foot. This makes dictating easier, of course, but it helps the typist even more. Typing from the recorder which does not have the advantage of this floor switch requires that the typist remove one hand from the typewriter each time she switches the recorder on or off. At normal dictating speed this means she must interrupt her typing every 30 seconds or so, and with some machines, it also means that the tape may have to be rewound several times to catch all of the wording on the tape.

Adding a foot switch isn't expensive. You can mount a simple single-pole, single-throw pushbutton switch to a plastic or rubber door stop. Then add a few cents worth of wire, a miniature phone jack and matching plug, and you have a foot switch as efficient as a manufactured one.

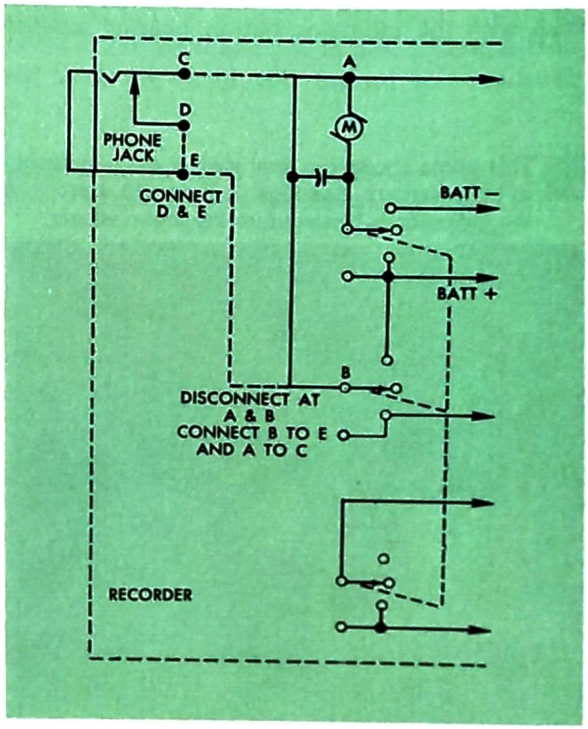
Connecting the foot switch into the recorder circuit requires one minor change in the recorder wiring. You will have to connect the phone jack in series between the battery and the motor.

Take a look at the schematic diagram. To make the wiring change, first disconnect the wire between points A and B. Now connect points B and E. Then connect points A and C. The jack



An added jack for the foot switch is mounted near the existing earphone jack to give a professional look

Partial circuit diagram shows the switch wiring that must be changed to allow for adding a foot pedal



dimmers, light: see electric control; lighting
disc sanders: see lathe accessories; sanding jig
disposal systems: see septic systems
distributor, auto: see auto repair; timing, auto engine
dividers, room: see hardboard projects; planters; remodeling; remodeling ideas; room divider
diving, skin: see skin diving; underwater camera cases
docks: see floats and docks

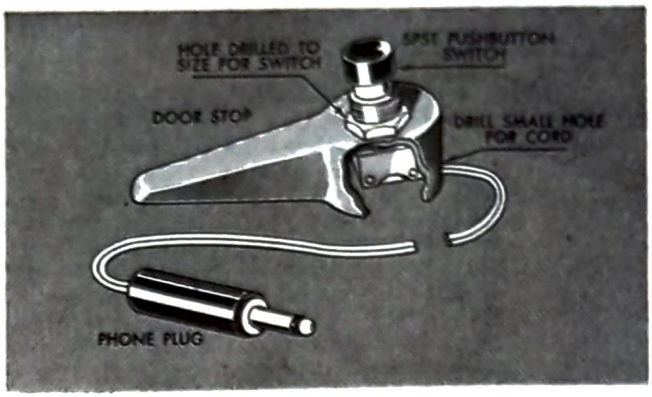
is now added to the circuit. Find a convenient mounting spot for it—possibly on the side of the recorder case or lined up with the earphone or microphone jacks already on the recorder.

As a final wiring step connect points D and E on the jack. This connection completes the motor circuit when the foot pedal is not being used, permitting normal use of the recorder.

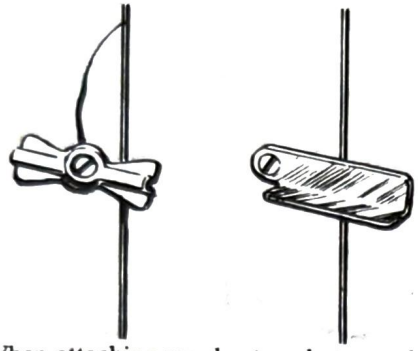
The foot switch which uses a rubber door stop as the case will not slide across the floor as a harder material might—holds its position. You may also want to adapt your recorder for dictation while you are driving your car. If you wish to make mobile dictating safer, replace the hand microphone with a throat microphone. Another alternative is to fasten the microphone onto the steering wheel so you can talk into it and still keep both hands on the wheel.

You may also find the foot switch to be useful when conducting taped interviews. The switch lengthens the amount of possible interview time.

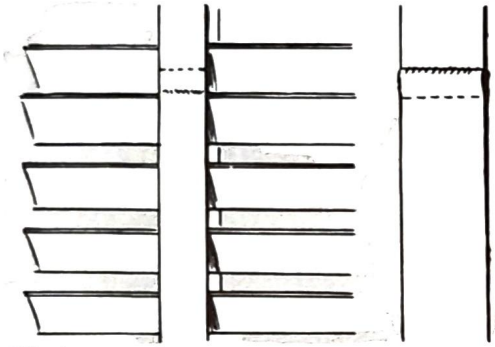
See also: hobby workspace; tape recorders; tapes, recording.



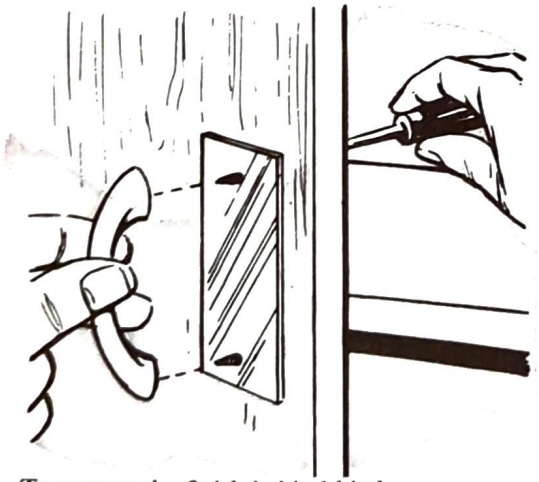
Here's how to make a foot pedal out of an ordinary rubber door stop. Use a single-pole, single throw pushbutton switch



When attaching regular turn buttons close to the edge of a window frame, the screw is apt to split the wood. This won't happen when you use off-set buttons made from aluminum angle.

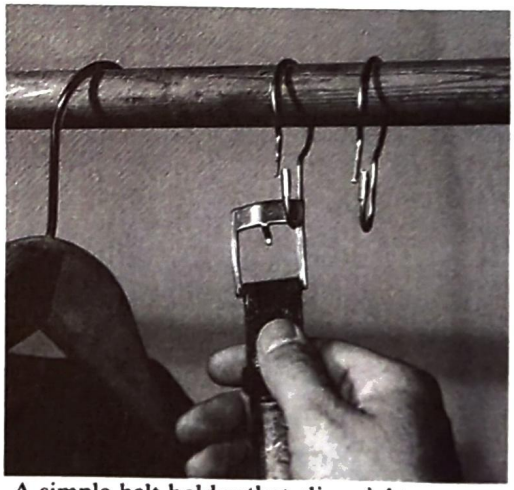


Blind tapes often stretch near the bottom so that the lower slats don't overlap properly. This can be remedied by sewing small tucks in the tapes where the slats don't lap.

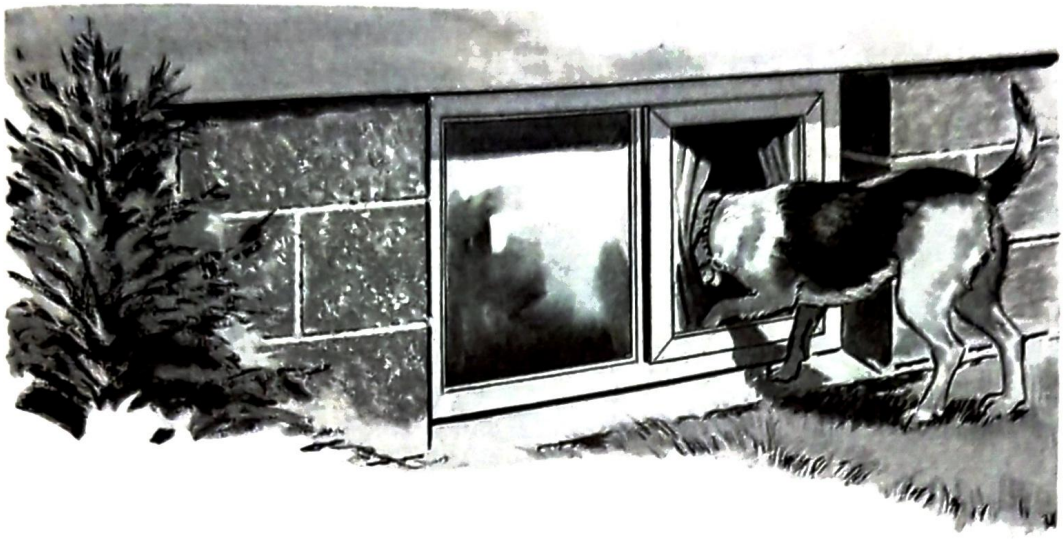


To protect the finish behind kitchen-cabinet pulls, place a sheet of thin plastic under the pull, drilling holes in it for pull screws. This protects the finish against wear and finger smudges.

An improvised vase made from two paper cups supports long-stemmed flowers in an adequate supply of water. Simply cut the bottom out of one cup, invert it over the other and tape it in place from the inside.



A simple belt holder that slips right over your closet rod is easily made from a shower-curtain hook. Bend the leg of the pin clasp back behind the hook to make it easy to remove the belts.



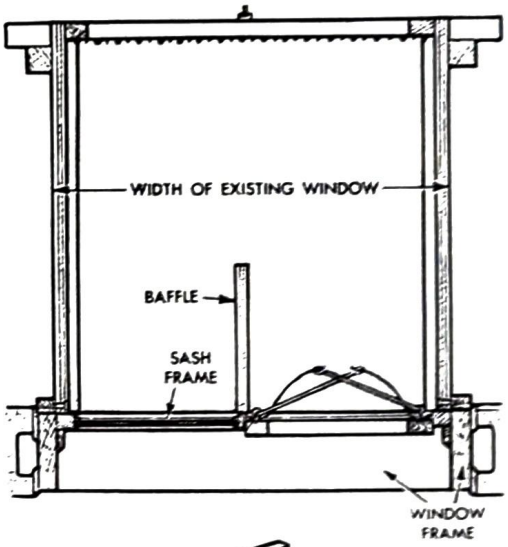
Winter quarters for your dog

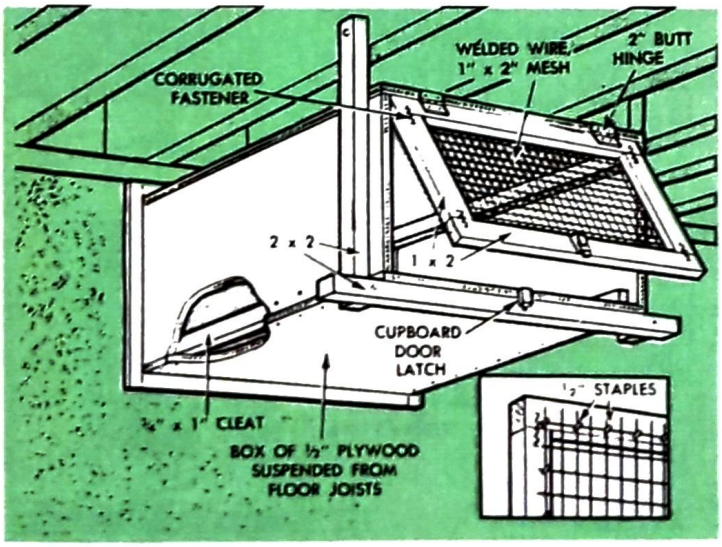
BY HI SIBLEY

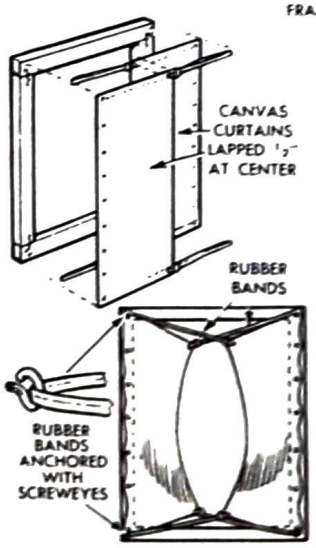
THIS FREE ACCESS, basement-window doghouse enables your dog to come and go as he pleases while providing him with warmth and comfort on wintry days. Suspended from the floor joists at a window near the furnace, it benefits from basement heat. Self-closing canvas curtains and a baffle keep out drafts. A hinged door on the basement side provides for feeding the dog, as well as for cleaning the interior of the doghouse.

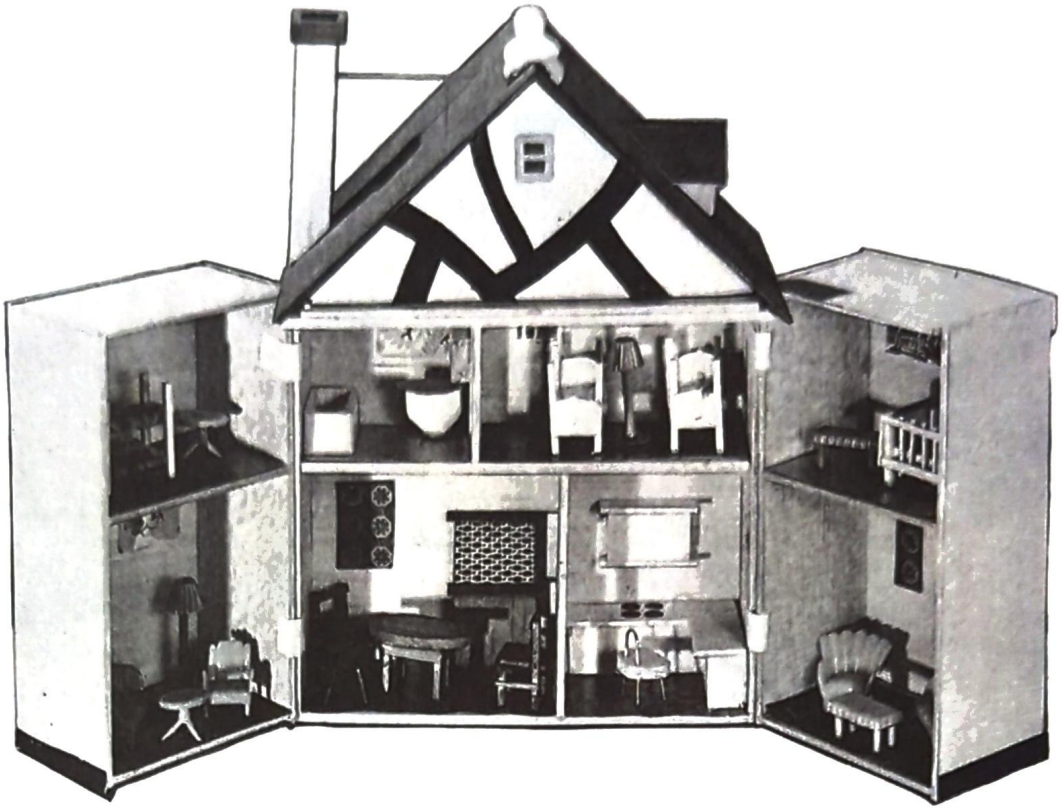
The curtained doorway frame fits in the glass rabbet of the removed window pane. Rubber bands to hold and activate the curtains may be cut from an old inner tube. Base all dimensions on the size of your window and your pooch.

See also: boy's projects.





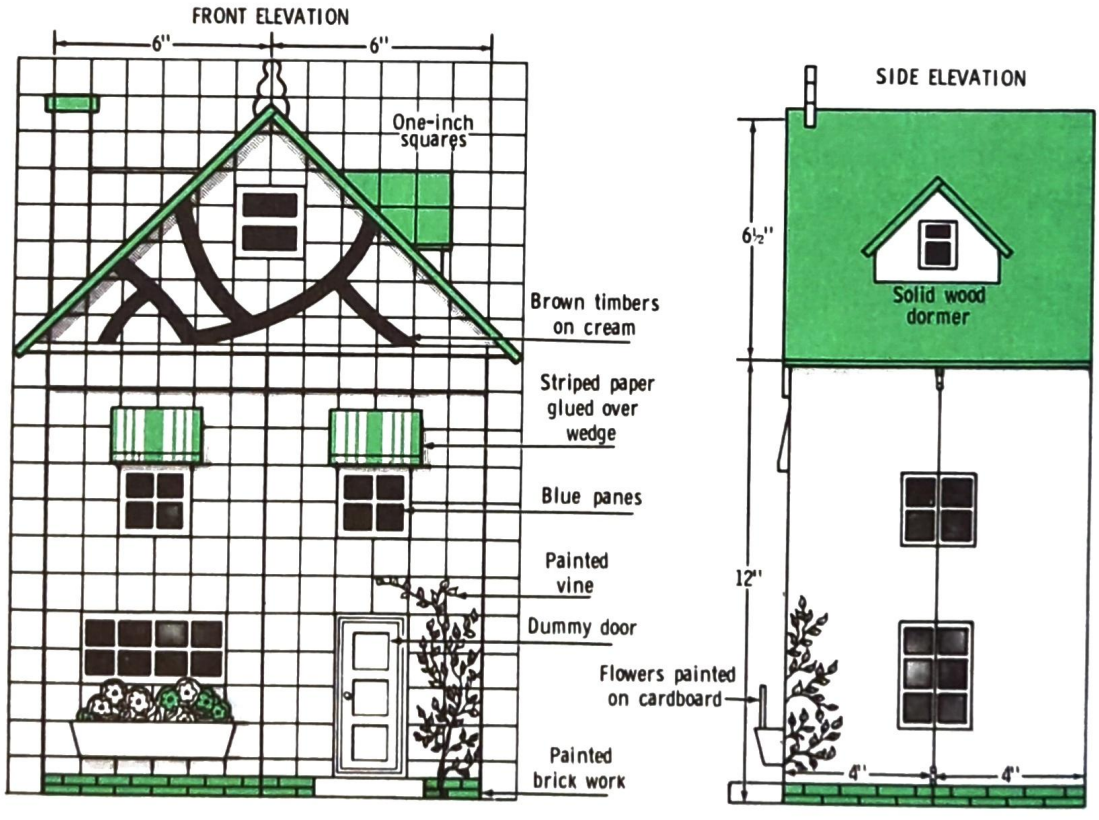




Folding dollhouse

BY HI SIBLEY

This gabled dollhouse, constructed from wood, offers privacy for young housekeepers with valuables to hide



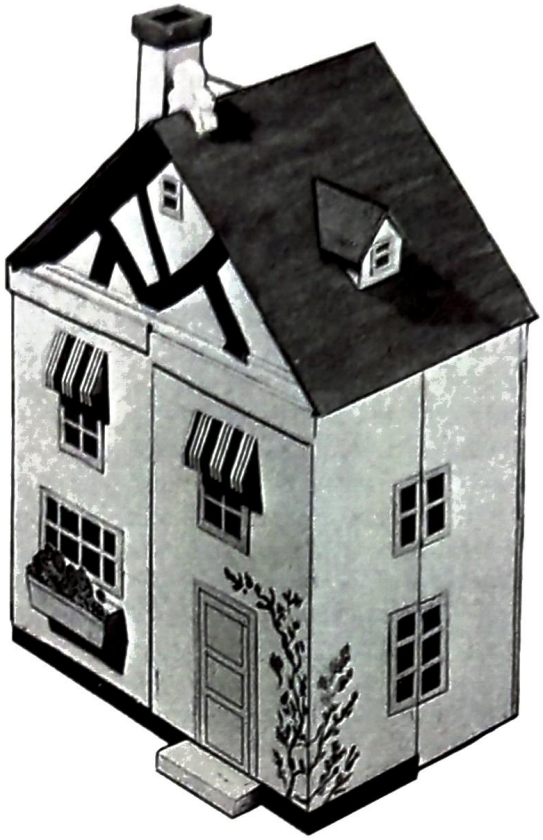
■ YOUNG HOMEMAKERS who prize their privacy will welcome a dollhouse that keeps snoopers from tampering with the rooms, once the hinged side sections are folded under the overhanging gable. There's even a secret attic where summer furniture may be stored. When closed, the dollhouse occupies only 8 x 12 in. of space.

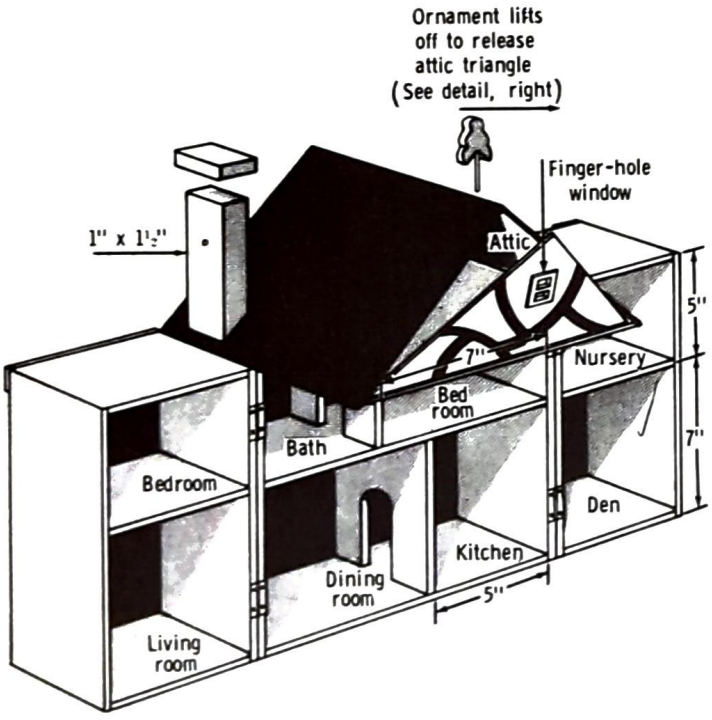
The best construction material—for both exposed and nailed edges—is ¼-in. pine, but you can substitute plywood. Apply glue to all butting surfaces during assembly, and attach the wings with four small brass hinges. Chimney, dormer and awnings are glued-on wood blocks.

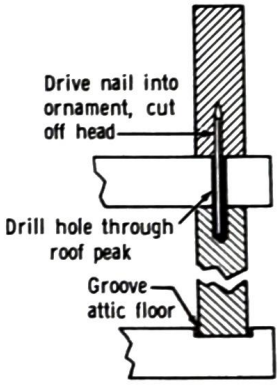
In the model shown, windows and doors are dummies, with stencilled blue panes; but the ones at front and back may be cut out with a coping saw, if preferred, to permit peeking into the closed house. At least the gable window should be cut out, to provide a finger hole for tipping the triangle forward so it can be lifted out of its groove. Enlarge the graph-squared pattern for the other details on the facade.

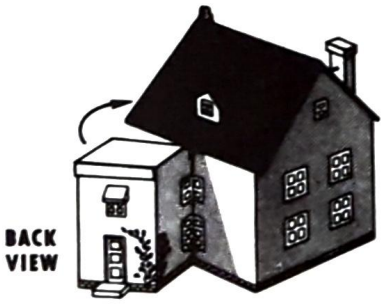
The house is scaled for the tiniest doll furniture sold in most variety stores. Or you can make furniture from wood scraps. You'll probably want to build in the kitchen counter, at least, and put a contact plastic on the floor.

See also: animal pin-ups; children's furniture; dolls; games, children's; kitchen, play; playhouses; puppet theaters; toys; tree houses.



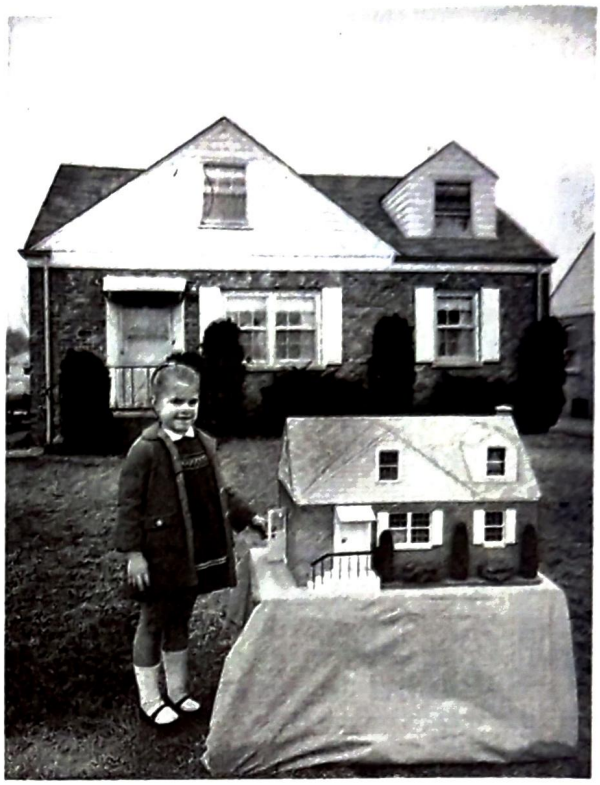






Your home in miniature

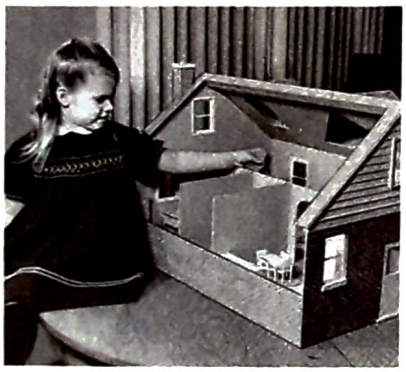
By DAVE SWARTWOUT

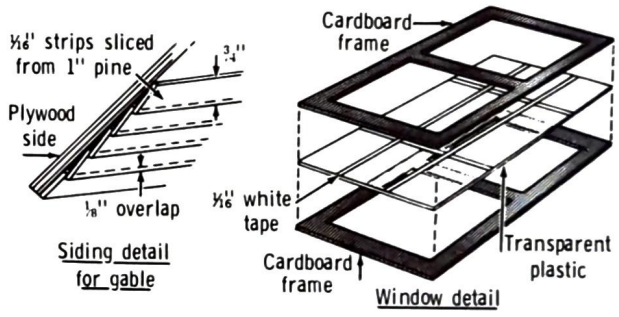


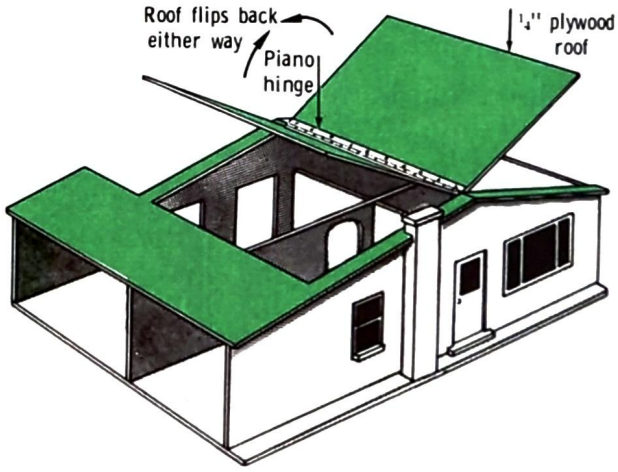
THE DREAM house of small children is the one they live in. What would thrill a little girl more, then, than a dollhouse that's a scaled-down replica of the family home?

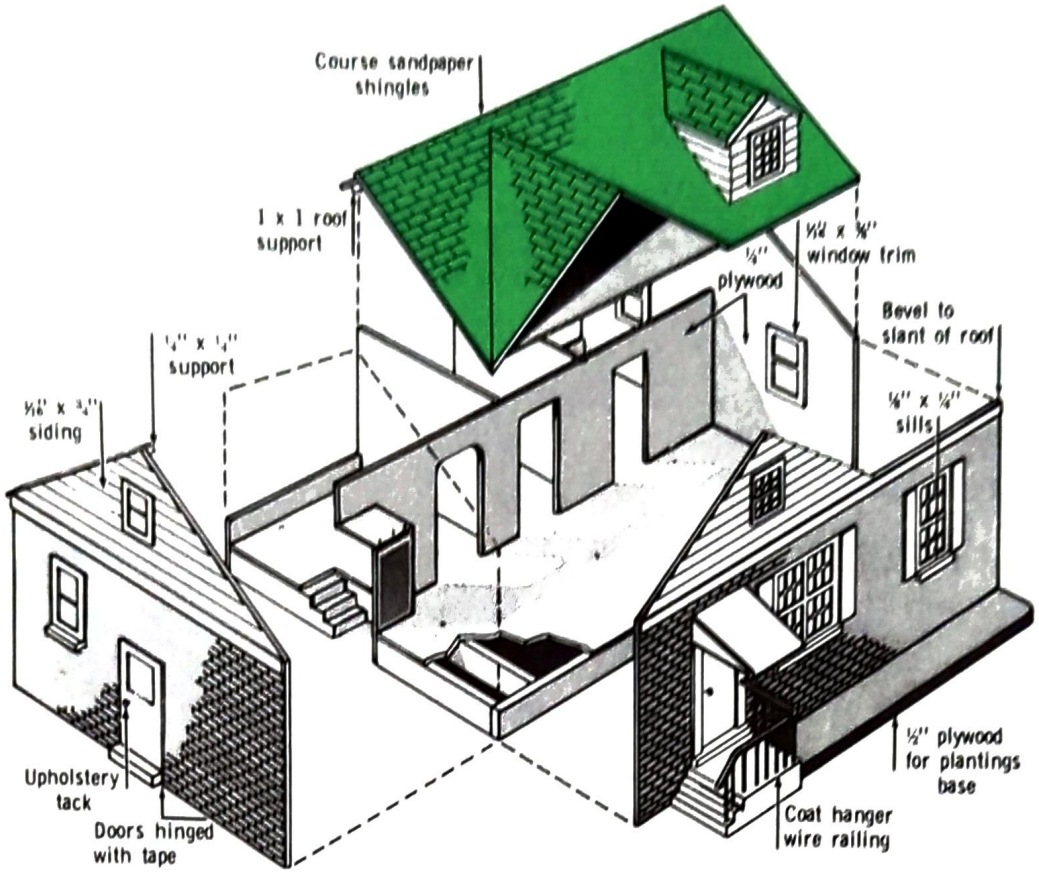
Exact plans, of course, can't be presented here. The best way to scale down your house is to photograph the front and side walls with a color-slide camera, shooting from a ladder to raise yourself level with the top of the ground-floor windows. Project these slides onto paper taped to a wall, moving the projector until the image matches a scale of, say, 1 in. Now, trace the outline of the wall, windows, doors and other details on the paper to form a pattern.

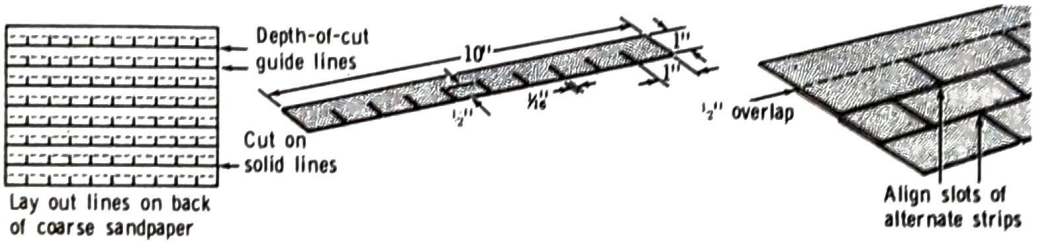
Lay out a floor plan to the same scale, eliminating closets and halls, and cut the floor and walls from ¼-in. plywood.

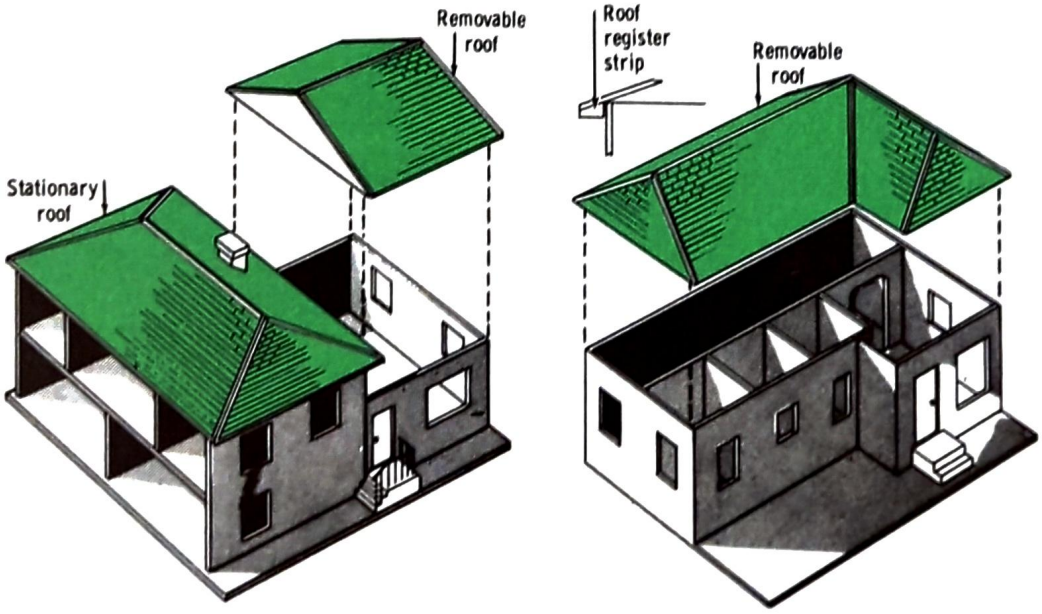







Course sandpaper shingles
1 x 1 roof support
¼" plywood
½" x ⅜" window trim
Bevel to slant of roof
¼" x ¼" support
1/16" x ¾" siding
⅛" x ¼" sills
½" plywood for plantings base
Upholstery tack
Doors hinged with tape
Coat hanger wire railing


Depth-of-cut guide lines
10"
1"
1"
1/16"
½"
Cut on solid lines
Lay out lines on back of coarse sandpaper
½" overlap
Align slots of alternate strips


Removable roof
Stationary roof
Roof register strip
Removable roof

Cornhusk dolls

HERE'S A DOLL that can trace its ancestry back beyond the *Mayflower*. Long before the first colonists arrived in America, Indians of the Penobscot and other tribes were making cornhusk dolls. The art of making these dolls was passed on to the settlers, and almost every little frontier girl had her own cornhusk family.

See also: animal pin-ups; children's furniture; dollhouses; games, children's; kitchen, play; playhouses; puppet theaters; toys; tree houses.

1 To prepare the husks, first trim off the thick woody base, then soak the leaves in water for a short time to make them more pliable and easier to shape

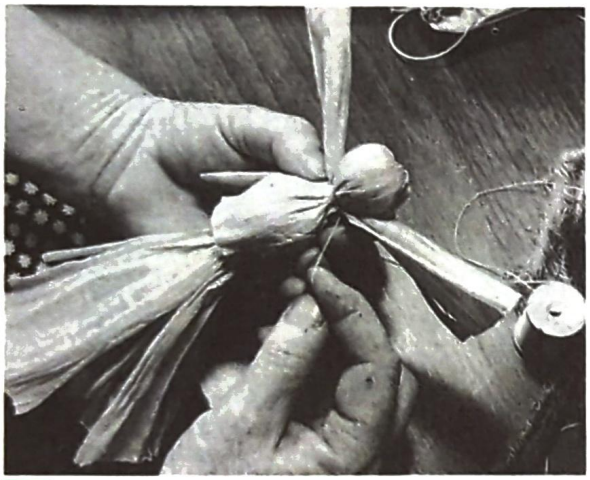
2 Begin by tying the waist of the figure with a piece of string. If the leaves don't compress easily, put them back in the water for additional soaking before trying again

dolly: see tripods

door alarm: see alarms, burglar

3 Spread the husks forming the upper part of the figure and insert a ball of husk to fill out the chest. The lower trimmed edges become the long old-fashioned skirt of pioneer days

4 Tie off the body husks at the neck, then crumple the remaining part into a ball to form the doll's head and cover it with a husk cut to the proper size. Choose a smooth one for the face



5 Arms for the figure are made from two rolled strips of husk. Tie these to the neck, at the same time securing the husk which covers the head and chest. Tie off small hands

6 Make the shawl and apron by wrapping a piece of husk around the shoulders and tying it at the waist. This string is hidden by a narrow piece of husk cut as a belt

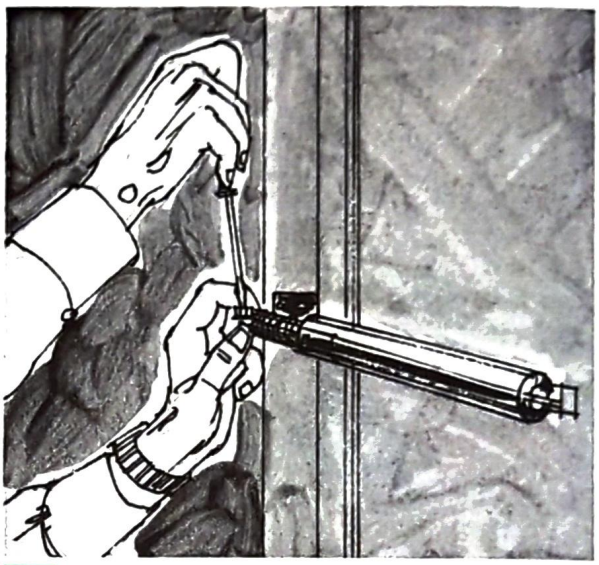
7 Use tassel silk for the hair. It can be curled, braided or even dyed, and it looks surprisingly real. Tie braids you make in the hair with ribbons cut from husk

8 To complete the doll, add a husk sunbonnet with scalloped edges, and draw the features with a pen. Smaller dolls can be made in the same way by using smaller husks

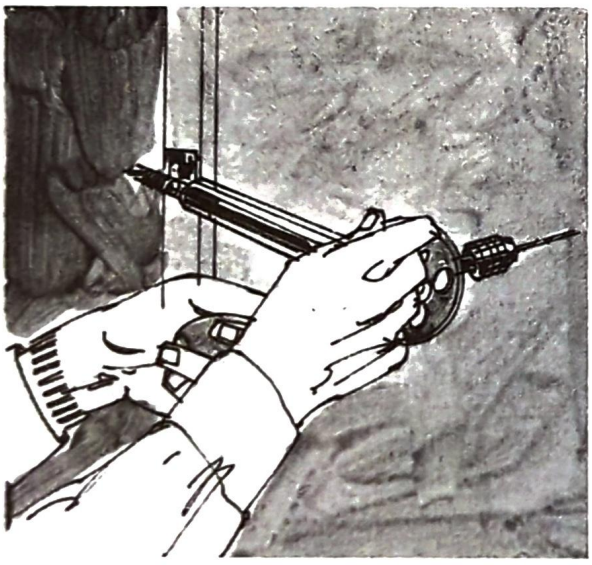
Inside a door closer

There are all types and sizes on the market; be sure to get the kind you need

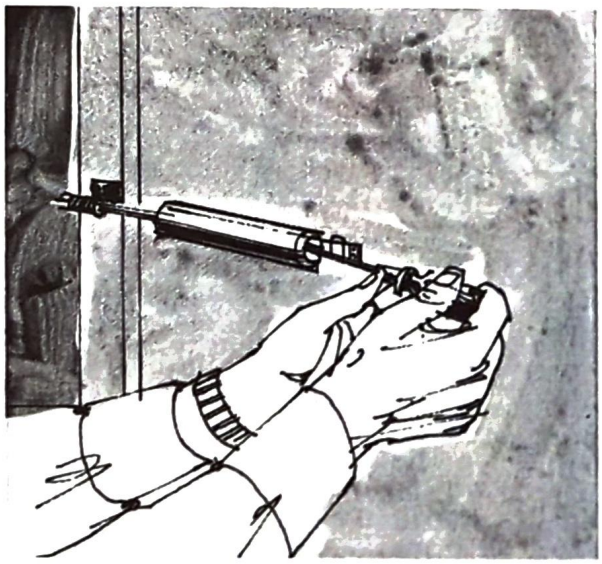
1 After deciding the right height for the closer, mark and drill the holes for the base plate, making sure that the plate is parallel to the floor. Before installing the timer, be sure that the door doesn't bind



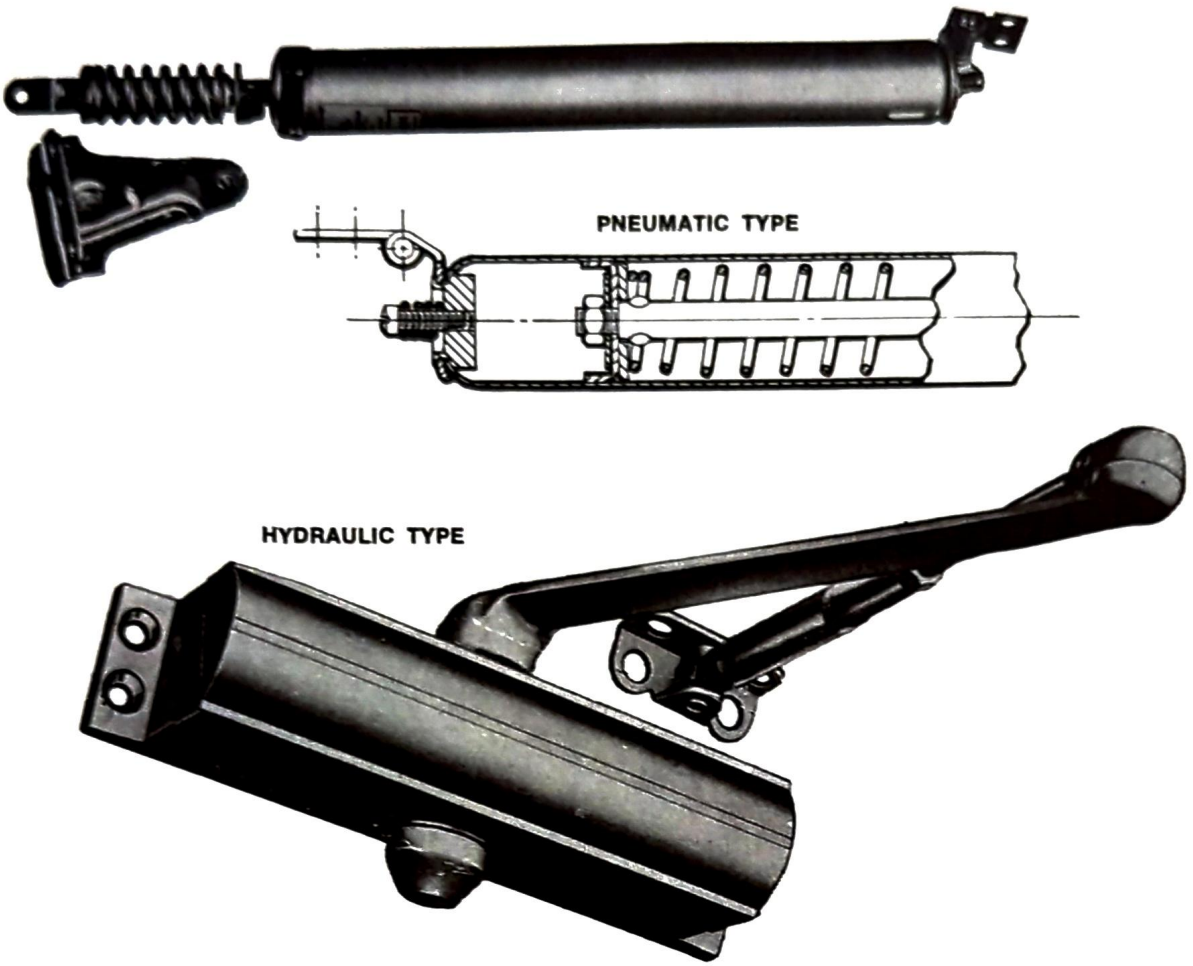
2 Once the base plate has been firmly fastened to the door jamb, attach the plunger rod to the plate and check the horizontal position. A screw and nut are provided for attaching the cylinder and plate



3 Mark the screw locations carefully for the cylinder after closing the door. Then drill the holes. On hollow doors, a wood block should be attached beforehand, to give more substantial support to the cylinder



4 Adjust the speed at which the door should close by turning the screw at the end of the cylinder. An air bypass lets all the air escape from the cylinder and supplies enough pull so that the door will close all the way



IF THAT STORM DOOR bangs shut or the inside door stands open behind you, you need door closers. But you should know what kind to buy.

Door closers are designed in many sizes and types for specific jobs. Inexpensive pneumatic (air) closers handle a lightweight storm or screen door nicely. But heavier doors require hydraulic closers with more power. In basic principle, pneumatic and hydraulic closers operate similarly. A spring pulls the door closed after it is opened. The spring reacts against a plunger that forces air or liquid through small openings. In this way, the opening and closing of the door are closely controlled throughout the swing.

Closers should offer only slight resistance on opening the door but should act instantly when the door is released, regardless of its angle. A closer that juts out from the door almost perpendicularly uses more space but provides good leverage. This toggle-joint arrangement usually is found on the hydraulic-type door closers.

Nearly all door closers adapt easily to either right or left-hand doors. If the room is arranged so that a person goes through it and continues straight ahead, a 100-deg. closer is ample. But if there's a change of direction at the door, a 140-deg. closer is needed to avoid undue stress on the door, frame and closer. It is best to mount the closer on the hinge edge of the door. A soffit bracket provides the greatest closing power but takes up more space. A corner bracket places the closer near the hinge edge of the door, reducing leverage and requiring a stronger closer.

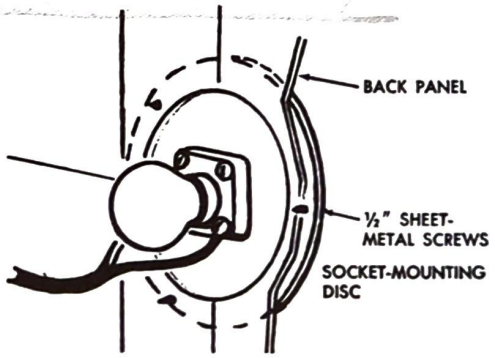
Some closers have delayed action that momentarily retards the initial speed of a closing door as it swings shut. And many closers are supplied with a holding mechanism to keep the door open at any desired angle.

Closers are not the remedy for doors that stick, so before a closer is installed the door should be made to swing freely, and any defect in the latch should be corrected. When installing closers, make sure that all screws are anchored in sound wood and turned in tightly, but not so tightly that they strip in the wood. Usually manufacturers furnish complete installation instructions with all closers.

See also: alarms, burglar; caulking; door decorations; garages, door openers; locks; remodeling; remodeling shortcuts; sliding doors; weatherstripping; woodworking.

Christmas door decor

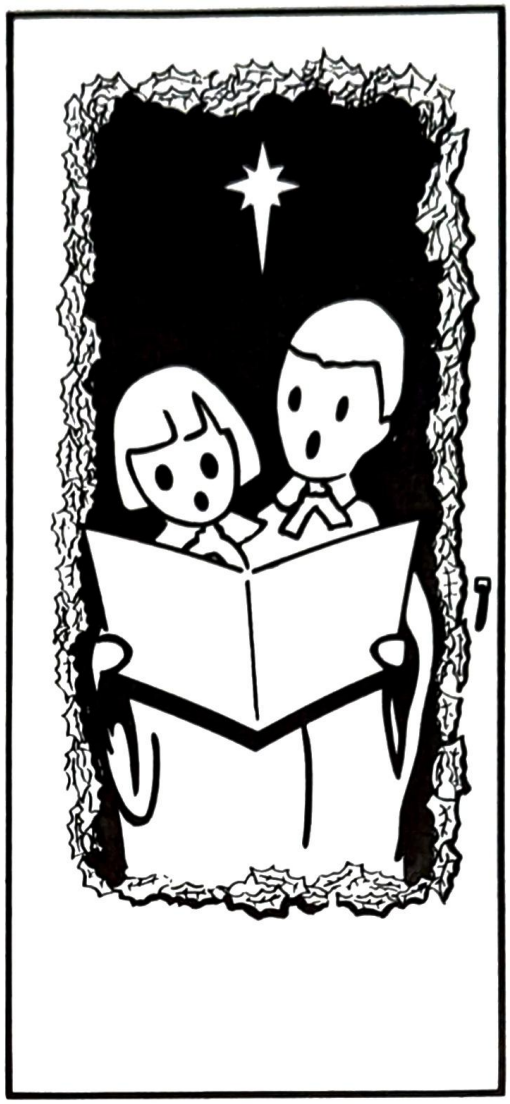
By DAVE SWARTWOUT

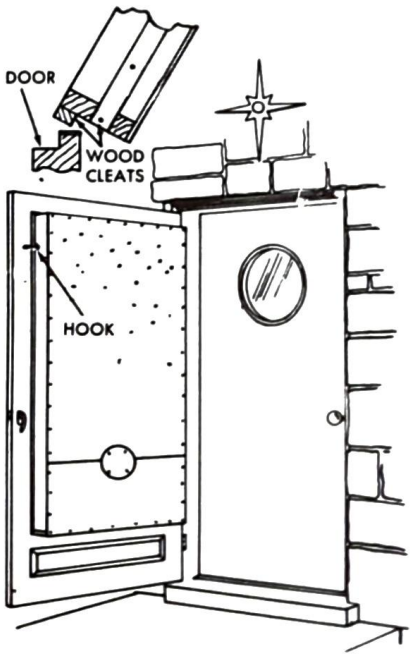


For Project-a-plans of these projects see page 959

door headers: see remodeling shortcuts
door locks: see locks
door openers, garage: see garages, door openers
doors, auto: see sliding doors
doors, weatherstripping: see weatherstripping

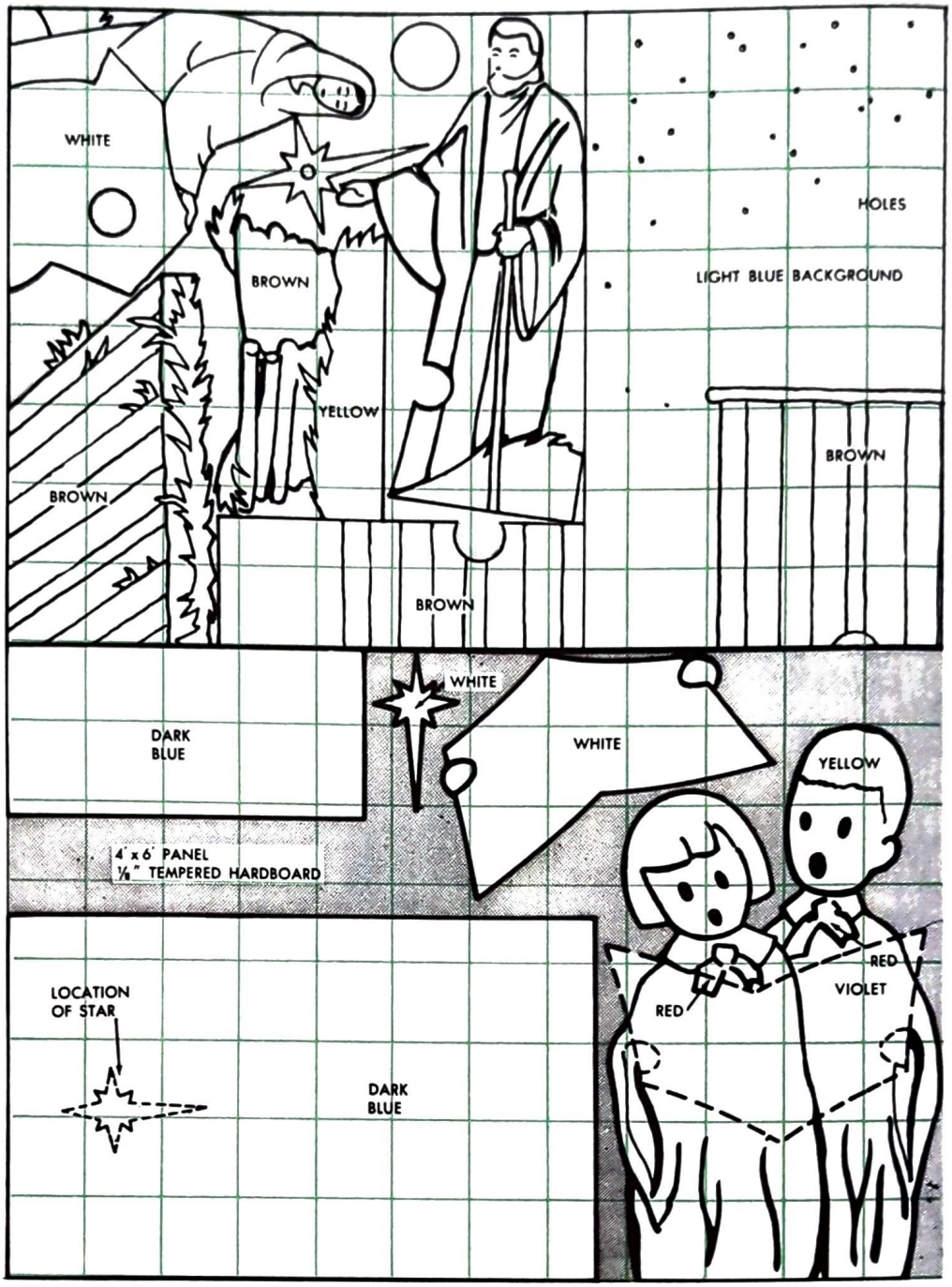
Lighting your display is the last step in construction. Just attach a small socket to a round hardboard panel that can be fastened to the back of the box with screws. Run the cord up the inside of the box and out to a porch outlet, tying it to the hinge pin to hold it in place when the door is open or closed





CHRISTMAS COMES BUT ONCE A YEAR, but everytime it does, you've got the same old problem: how to get the spirit of the season into your yard and around your house in a different, unusual way.

Here is something different in the way of Christmas cutouts to help you solve this recurring problem. Two of these projects are holly-framed shadow boxes made to fit your storm door in place of the glass insert. A third project features



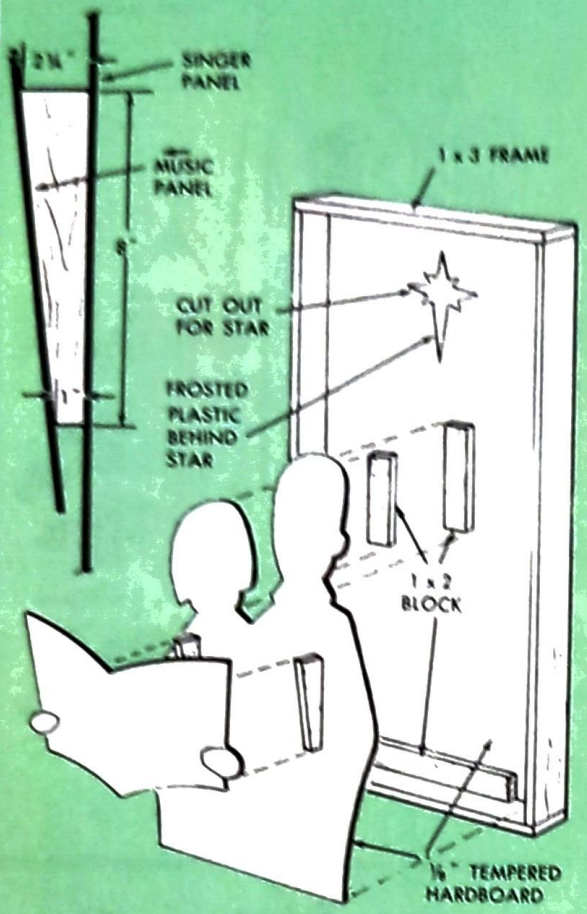
Christmas door decor, continued

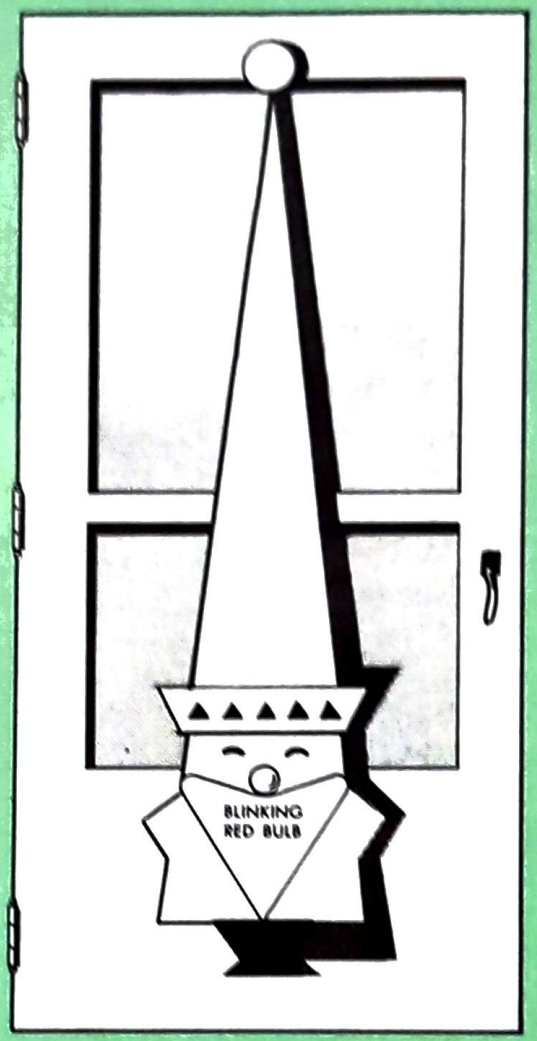
a high-hatted Santa with a blinking red nose, and it attaches to the outside of the door.

Once again, you can use the exclusive Project-a-plan to project the designs on the material out of which you are going to cut the figures. The designs are reproduced for you, ready to make into 35-mm slides, on page 959.

As a first step, no matter which of the designs you finally settle on, measure your screen door to determine the correct size for your display. Then build the background box, using ⅛-in. tempered hardboard as a back panel, framed with either 3-in. strips of ½-in. plywood or 1 x 3 stock. Next cut cleats to fit the rabbets of the opening in the door and mount these solidly along the edges of the box with glue and nails.

The regular catches which hold the screen or storm window in place are strong enough to secure the display to the door, but it's a good idea to add screen hooks near the top.





Here's another idea to consider: once you have made the background box, it can be used every year, with perhaps no more than repainting, while you can cut out and install a new and different set of figures to vary your decorations from year to year. And incidentally, the very same background box with a witch or a pumpkin cutout and trimmed in leaves would be fine for Halloween

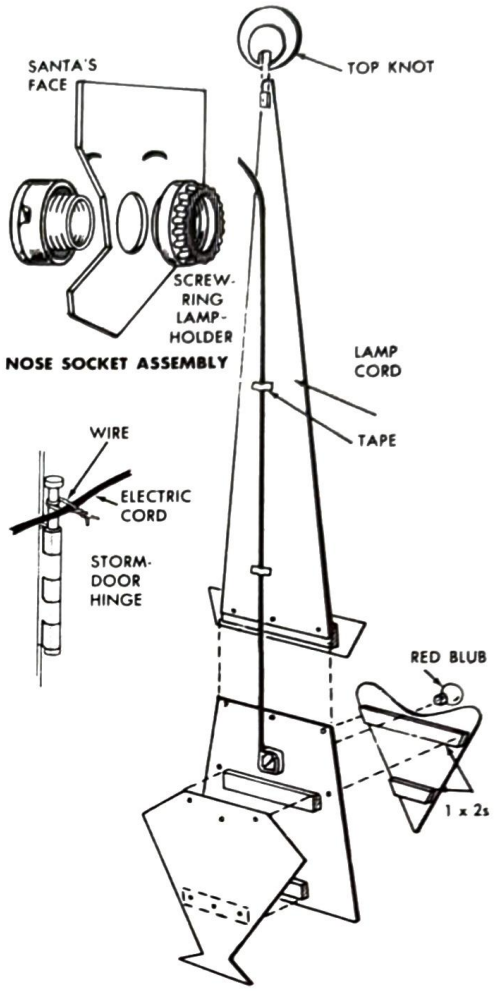
turn page

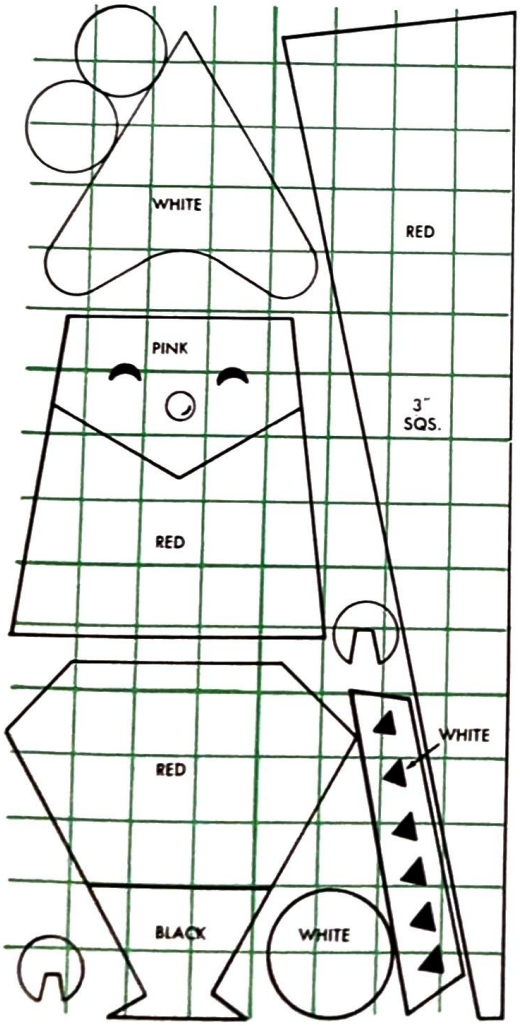
Before cutting the figures, mark out an area the size of the box on the panel to be cut, then set up the projector so that the back-panel image fits this area and trace the pattern for the back. You can usually trace the other figures without moving the projector.

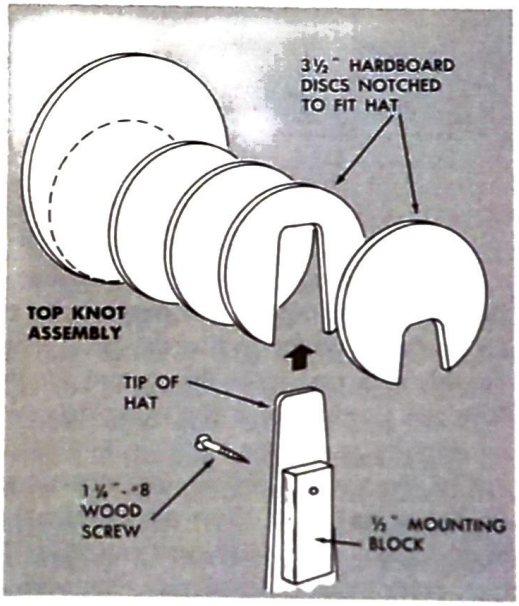
Cut the various shapes out with a saber-saw or jigsaw and give them an undercoat of outdoor enamel. When dry, you can paint the separate areas with quick-drying enamels. Finally, assemble the inserts with glue and brads. Put cutouts or holes in the back panel only if your main door has a glass insert.

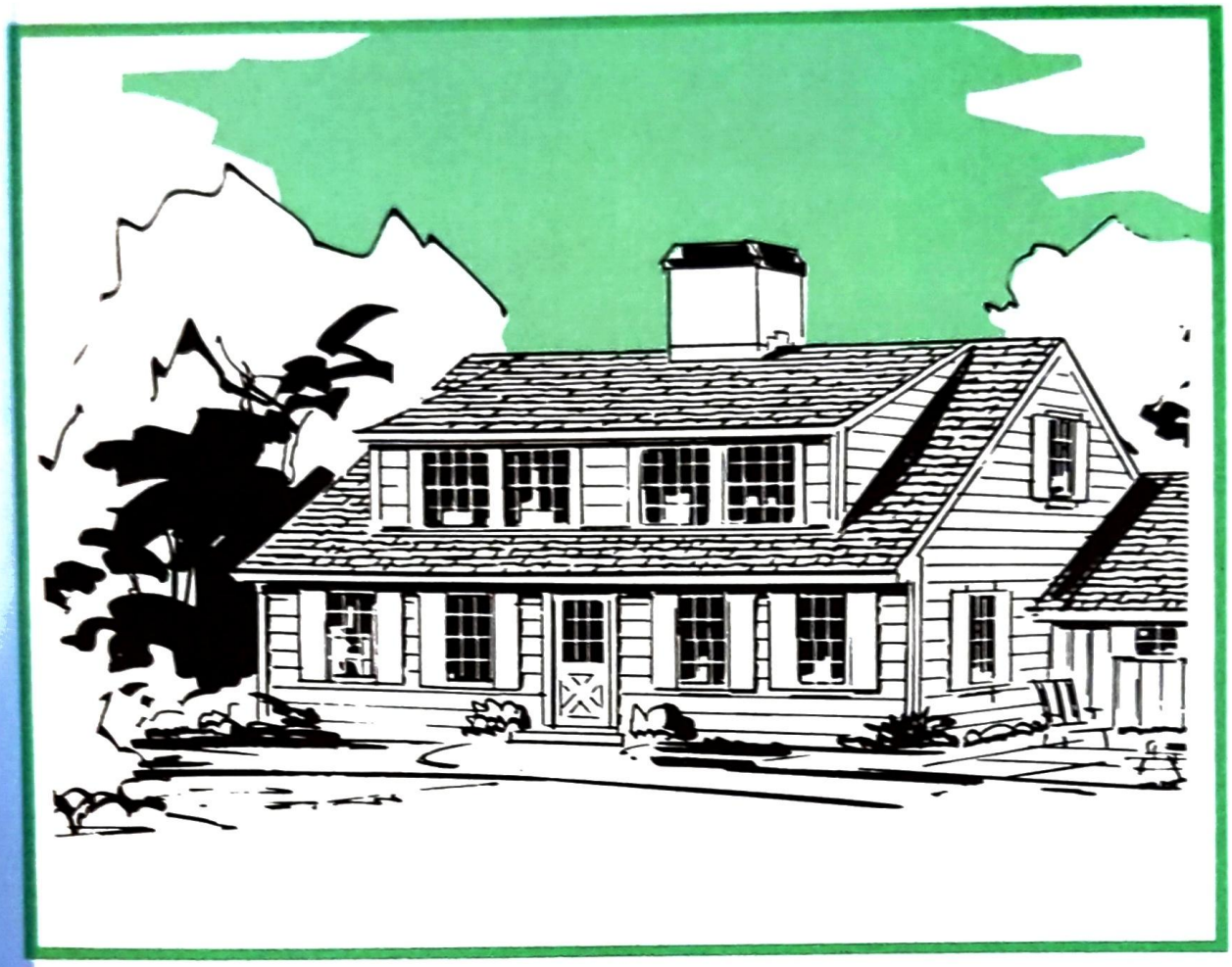
If your storm door is metal, you'll have to make the box a bit shallower and bolt it to the face of the door. Use ⅛-in. aluminum bolts with aluminum washers, two each at the top and bottom. After Christmas, tighten the bolts in place.

See also: Christmas decorations; Christmas displays; gifts, Christmas; house decorations; yard decorations


SANTA'S FACE
TOP KNOT
SCREW-RING LAMP-HOLDER
NOSE SOCKET ASSEMBLY
LAMP CORD
TAPE
WIRE
ELECTRIC CORD
STORM-DOOR HINGE
RED BLUB
1 x 2s


WHITE
RED
PINK
3" SQS.
RED
RED
WHITE
BLACK
WHITE


3½" HARDBOARD DISCS NOTCHED TO FIT HAT
TOP KNOT ASSEMBLY
TIP OF HAT
1¼"-#8 WOOD SCREW
½" MOUNTING BLOCK



Roof dormers put attics to work

Here are the basic facts you need for styling and installing a dormer to perk up your home's roof line

GOT A YEN to raise the roof? There's no more practical way than adding a dormer—and it's the easiest means of increasing usable floor space. Even a single-sash dormer adds headroom.

If properly proportioned for the existing roof, dormers can greatly improve the appearance of your home, as the sketch above demonstrates. Even if not creating rooms, they can bring light and air into that musty attic storage space.

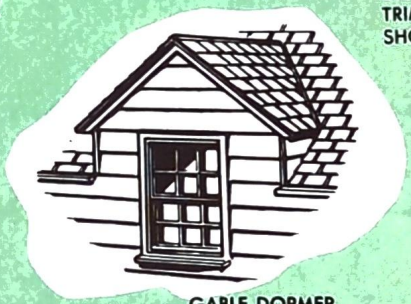
One of the four types sketched on pages 802 and 803 should meet your needs. To help you decide on the style and size, try scaling these designs on tracing paper so you can position them over a sketch or photograph of your house. Choose the dormer that best complements the structural style and proportions. Then study the framing principles of the different designs to determine whether the job's within the scope of your abilities. No dimensions are given since these depend on area and pitch of the existing roof.

If you tackle the job alone, remember it won't be a one-day project. Before you chop a hole in your roof, be sure you have a tent or tarp on hand that's big enough to cover the opening in case of rain. Just tack a plank or two across the hole before spreading the tarp, then anchor its edges with sandbags.

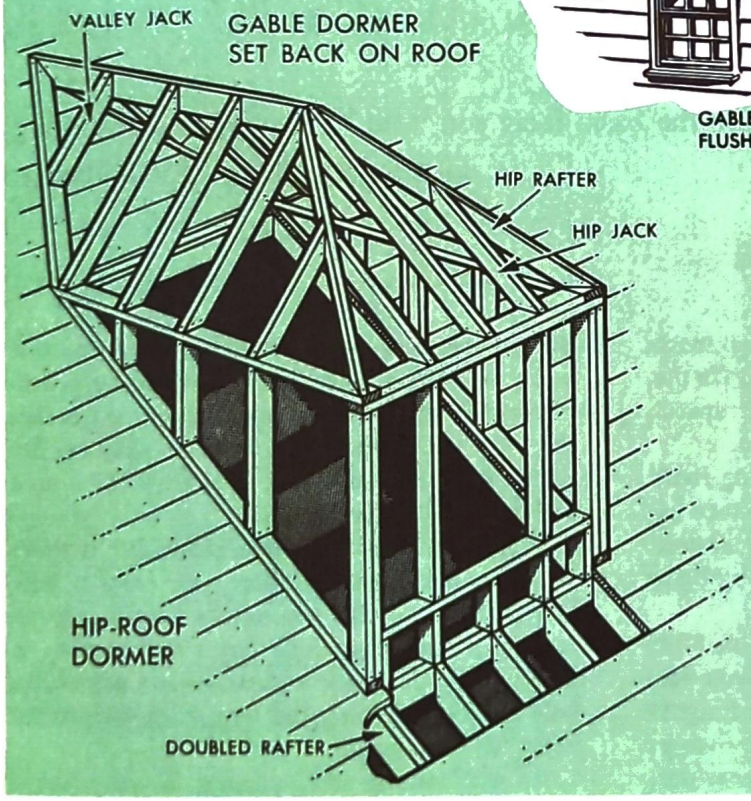
As with cutting new openings in walls, some

roof dormers put attics to work, continued

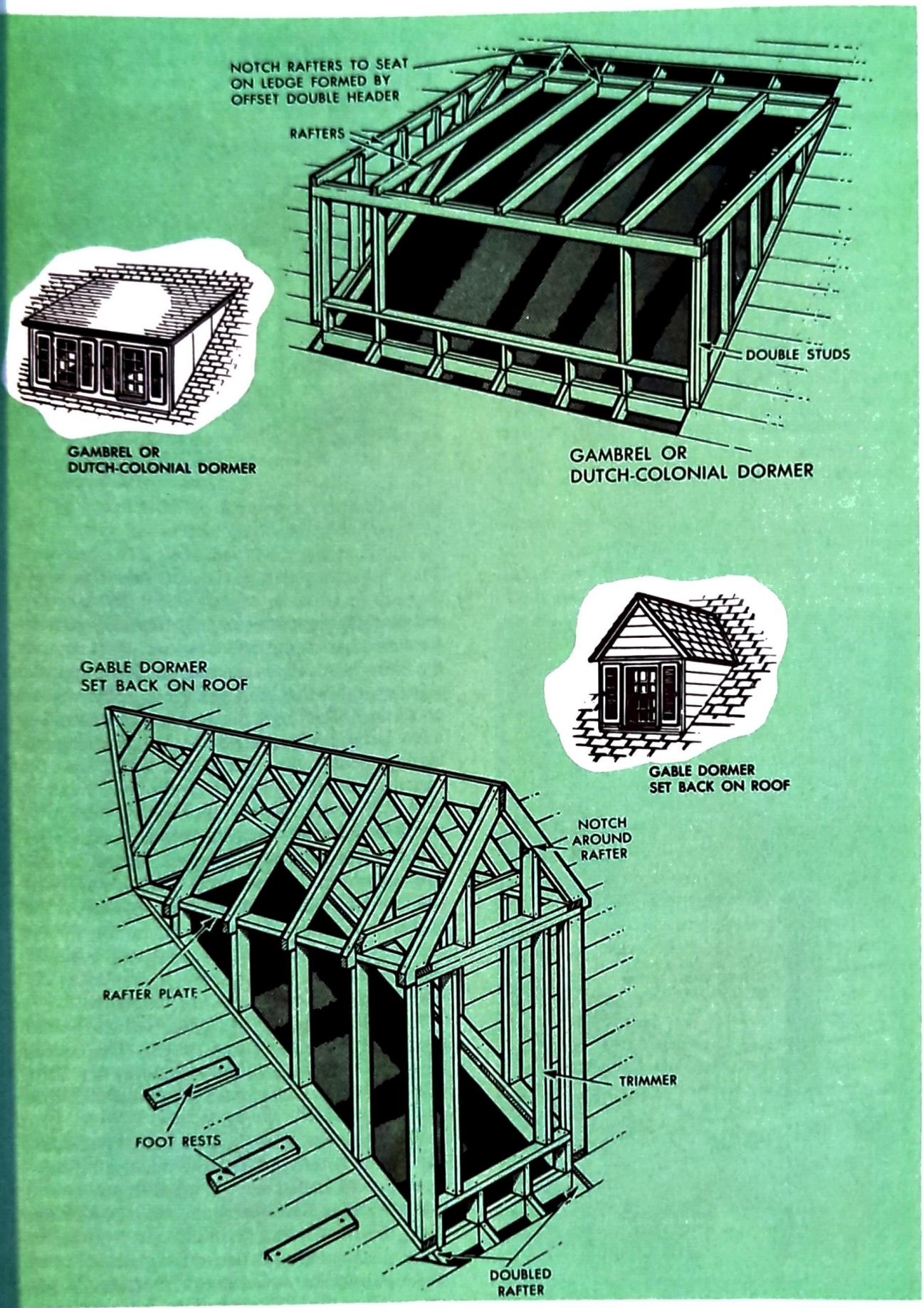
GABLE DORMER FLUSH WITH WALL

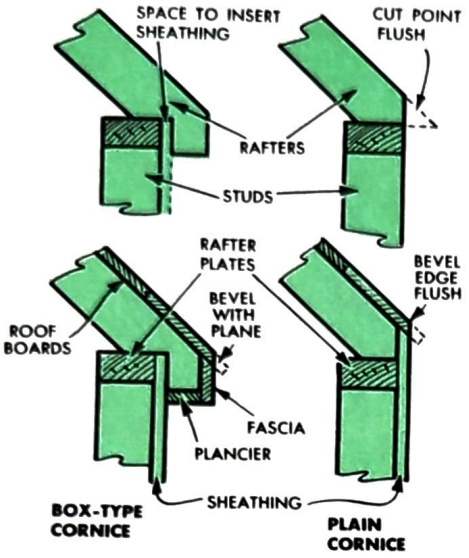


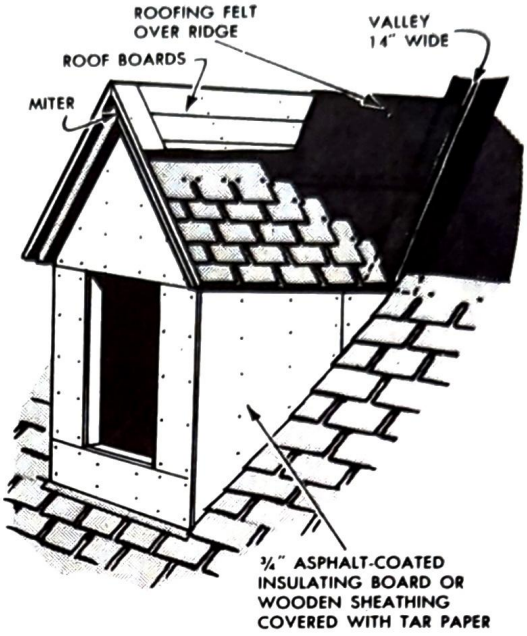
GABLE DORMER FLUSH WITH WALL



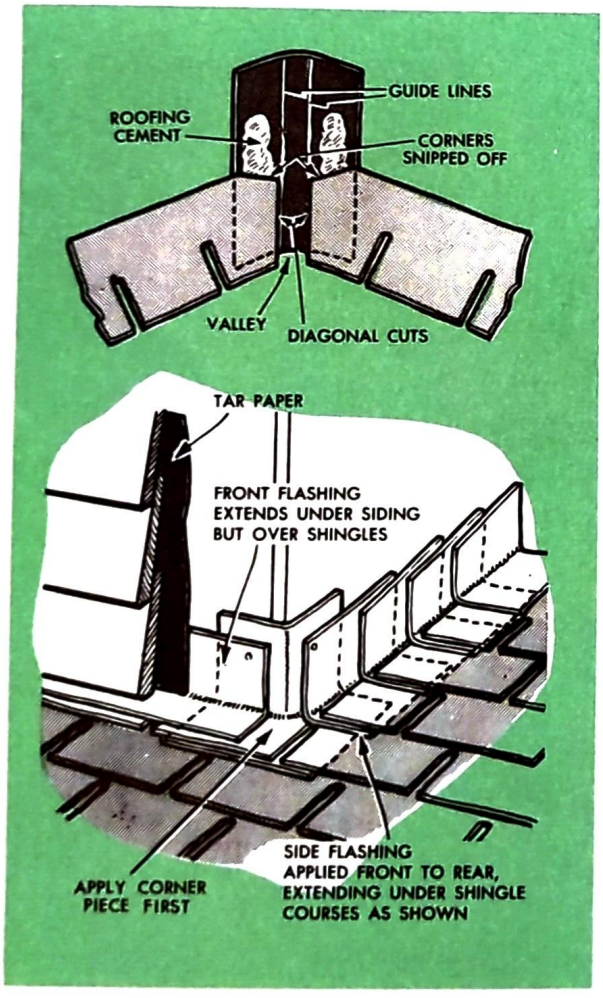
HIP-ROOF DORMER


NOTCH RAFTERS TO SEAT ON LEDGE FORMED BY OFFSET DOUBLE HEADER
RAFTERS
DOUBLE STUDS
GAMBREL OR DUTCH-COLONIAL DORMER
GAMBREL OR DUTCH-COLONIAL DORMER
GABLE DORMER SET BACK ON ROOF
GABLE DORMER SET BACK ON ROOF
NOTCH AROUND RAFTER
RAFTER PLATE
TRIMMER
FOOT RESTS
DOUBLED RAFTER




ROOFING FELT OVER RIDGE
VALLEY 14" WIDE
ROOF BOARDS
MITER
¾" ASPHALT-COATED INSULATING BOARD OR WOODEN SHEATHING COVERED WITH TAR PAPER

dormers put attics to work, continued


GUIDE LINES
ROOFING CEMENT
CORNERS SNIPPED OFF
VALLEY
DIAGONAL CUTS
TAR PAPER
FRONT FLASHING EXTENDS UNDER SIDING BUT OVER SHINGLES
SIDE FLASHING APPLIED FRONT TO REAR, EXTENDING UNDER SHINGLE COURSES AS SHOWN
APPLY CORNER PIECE FIRST

reframing is necessary to help remaining structural members carry the extra load. First, lay out the dormer location carefully and pry up the shingles within that area and about a foot beyond on all sides. Trim back the roofing paper to within a few inches of the shingle line. Before doing any cutting, double the rafters that will frame the opening, cutting the new rafters so they'll extend at least 3 or 4 ft. beyond the top and bottom of the hole. Then saw the roof boards along the inside of these doubled rafters, and across the top and bottom of the marked-out opening. The trimmed boards above and below will support the cut rafters until you can fasten in the double headers (using 20d nails), as shown in the sketch. The opening should extend one roof-board width past the marked-out area at top and bottom.

The lower edge of the upper double header should be located at ceiling height. The bottom header members have their top edges set flush, at a height that will put the sill 28-30 in. above the floor.

Whenever possible, the side walls of the dormer should be erected over the doubled rafter—on sole plates nailed through the roof boards and into the rafters beneath (again using 20d nails). Build the front frame first, and nail it in place, bracing it plumb until the rafter plates (cut by direct measurement back to the roof) are in position. Then add the side studs, spacing them

16 in. o.c., driving 16d nails down into them through the rafter plates, and toenailing their lower end to the sole plate with 10d nails. Next, cut one end of a 1 x 6-ridge board to match the roof slope, leaving it overlong; level it by tacking it to a temporary prop standing on the header above the sash opening. Now, lay off for a master rafter you'll be able to use as a cutting pattern for all rafters except the valley jacks.

Since spans are short in dormer construction, light framing stock is often selected. It isn't unusual for dormers to be framed with 2 x 4s (or even 2 x 3s) in roofs with existing rafters of 2 x 8s or 2 x 10s.

Nail the rafters in place with 10d nails, starting from the outer end; then trim the ridge board flush with the outer rafters. A shed-type dormer, such as the gambrel shown, avoids all ridge-board fitting. It is used where headroom is the major concern.

The rough window opening is centered in the front frame and should be 4¼ in. wider than the sash unit itself. Whether the trimmer studs are single or double depends on their proximity to the corner posts. When they're close, as in three of the framing details on pages 802 and 803, double trimmers aren't needed. The fourth detail shows a flush-with-wall dormer where the corner posts are merely nailed to existing studs to extend a section of the wall upward; in this case, the rough framing of the window calls for double trimmers.

nail up a drip board

The front cornice construction depends on which type of side cornice you choose (see sketches at top of page 804). In any case, the roof boards run only to the *inside* face of the front rafter, where they are nailed to a 2 x 2-cleat fastened along the upper inside edge of this rafter before it is put in place. A "drip board," running at right angles to the roof boards, is nailed to the edge of the rafter itself, to create the front overhang. In plain cornice construction, this overhang is braced by trim, but for the box type you extend the plancier (or soffit board) its own width beyond the front rafter so you can "turn the corner" with it, nailing the front plancier to a second cleat fastened along the *lower front* edge of the rafter. Though the sketches show the roof boards beveled flush with the side fascia or sheathing they may project an inch or so if you prefer.

Before shingling, lay a 14-in. sheet-metal valley where dormer and house roof meet, bending it until it lies flat against both roofs (see sketches, page 804). Snap chalklines up the valley to indicate where shingles must be trimmed. The top corners are also snipped off, to shed water toward the valley. To avoid nailing through the valley, anchor the diagonally-cut edges of the shingles with cement.

Where the dormer walls meet the roof, use step flashing, starting with a corner piece and working back each side, as shown in the bottom sketch, page 804. The side pieces should be 6 in. long, with the vertical flange extending at least 3 in. up under the siding and the other flange 4 in. out under the shingles. Don't nail the shingles through the flashing. The front strip rides on top of the shingles.

Sheathing can be either ¾-in. asphalt-coated insulating board or wooden sheathing covered with tar paper. After putting up the sheathing, apply a finish material—asbestos shingles, lap siding, etc.—to match the exterior of the house.

insulate the interior

Finish the interior by first applying batt insulation, either fiberglass or mineral wool, using a staple gun to tack it to the studs and rafters. Insulation batts faced with aluminum foil to serve as a moisture barrier are also available. All insulation batts go up quickly and are low in cost.

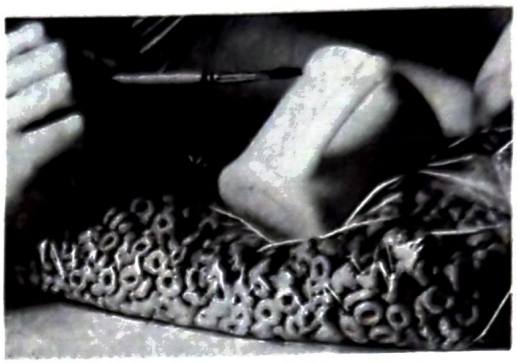
Finish the interior with gypsum drywall, taping the joints and painting, or panel the room with one of the wall panelings available, such as hardwood plywood, hardboard with a decorative finish or tongue-and-grooved knotty pine.

If the floor of the attic was unfinished before you began the roof raising project, put in a subfloor, and then add a finish floor. Oak flooring was standard hardwood flooring for years, but now many other floorings—vinyl tiles, for example, hardwood tiles, and decorative linoleums—are also available. If you are going to use one of these, put an underlayment down over the subfloor. Sheets of plywood or hardboard are used for underlayment, and provide a smooth level base for the finish floor.

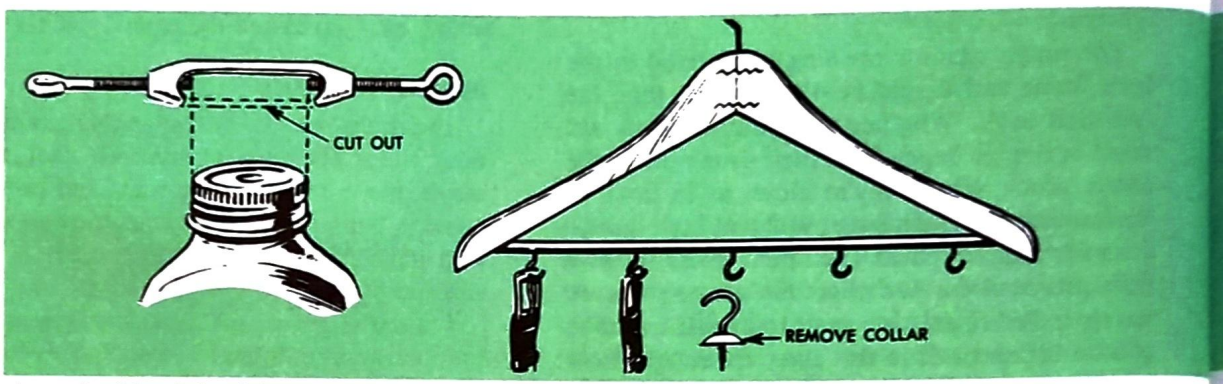
It's a good idea to install a storm window in your new dormer at the time you put in the window, since you will most likely want to add one later anyway. Because the dormer windows are hard to get at for washing or for putting up and taking down storms, consider installing the type of window sash that can be removed from the inside, and triple-track storm windows that provide self-storage.

See also: attic remodeling; building; roofs; sewing center.

One sure way to start a nail in a place too high to reach with both hands is to press the nail through a small square of foil and then wrap the foil tightly around the head of the hammer.



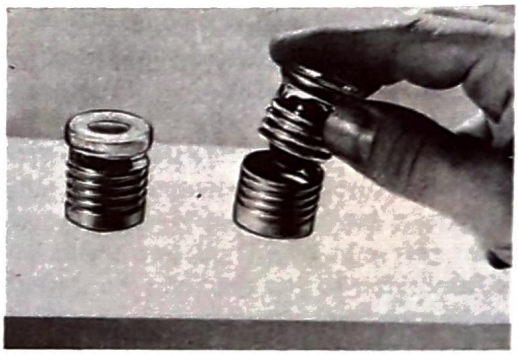
Hobbycrafters who paint china or other objects difficult to hold in working position will find that a plastic bag filled with beans, breakfast food, or other particle material is just the thing.



A turnbuckle of the right reach makes a good wrench for those stubborn screw-type jar lids. Cut away one "buckle" as shown, drop it over the cap and tighten the screweyes.

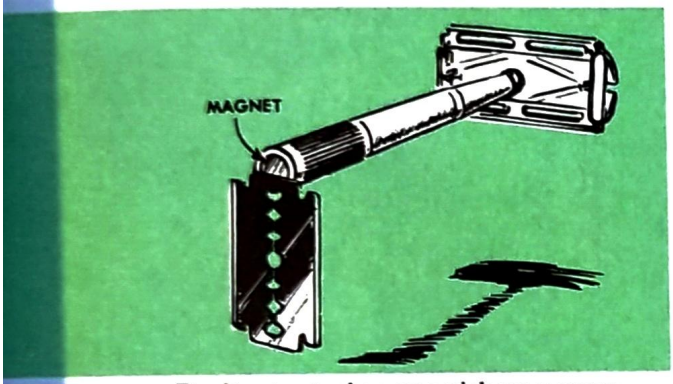
Belts are always at hand when you hang them from the pants bar of a wooden garment hanger. Remove the collars from several cup hangers, drill small spaced holes in the bar, turn the hooks in.

It's easy to remove and replace a single floor tile if you heat the damaged tile with an infrared lamp until the adhesive is softened.

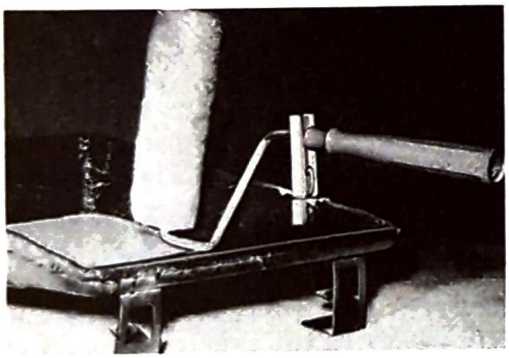


Avoid the problem of searching for a new fuse when one blows by keeping replacements in socket shells mounted on a board nearby.

A hollow rubber ball slit about one fourth the way around the circumference makes a spill-proof container that is easy to open and close.

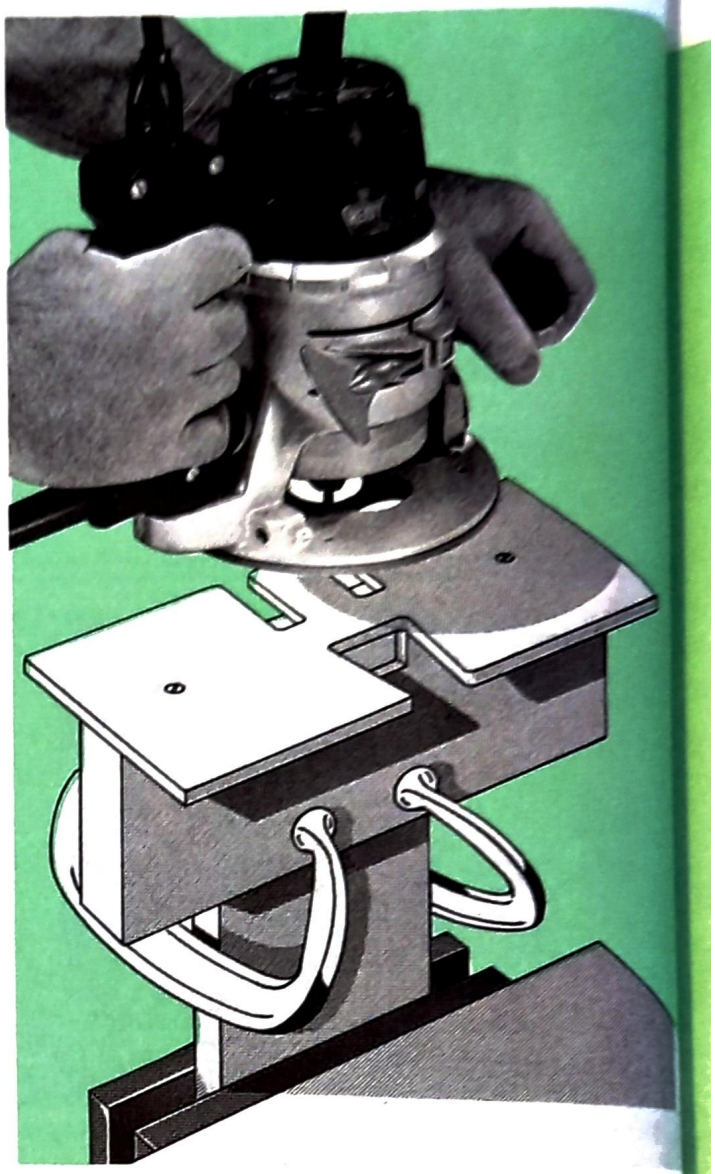


Don't get cut when you pick up a razor blade from the floor. Instead, wedge a round magnet into the hollow end of the razor and use this to pick up the blade.



A clothespin clipped to the side of your roller pan will keep the roller's nap from flattening out while you pause for a coffee break or lunch.

A pail filled with water serves as a portable fender to protect your plants when you pull the garden hose around a flowerbed.



Jigs for perfect dovetail joints

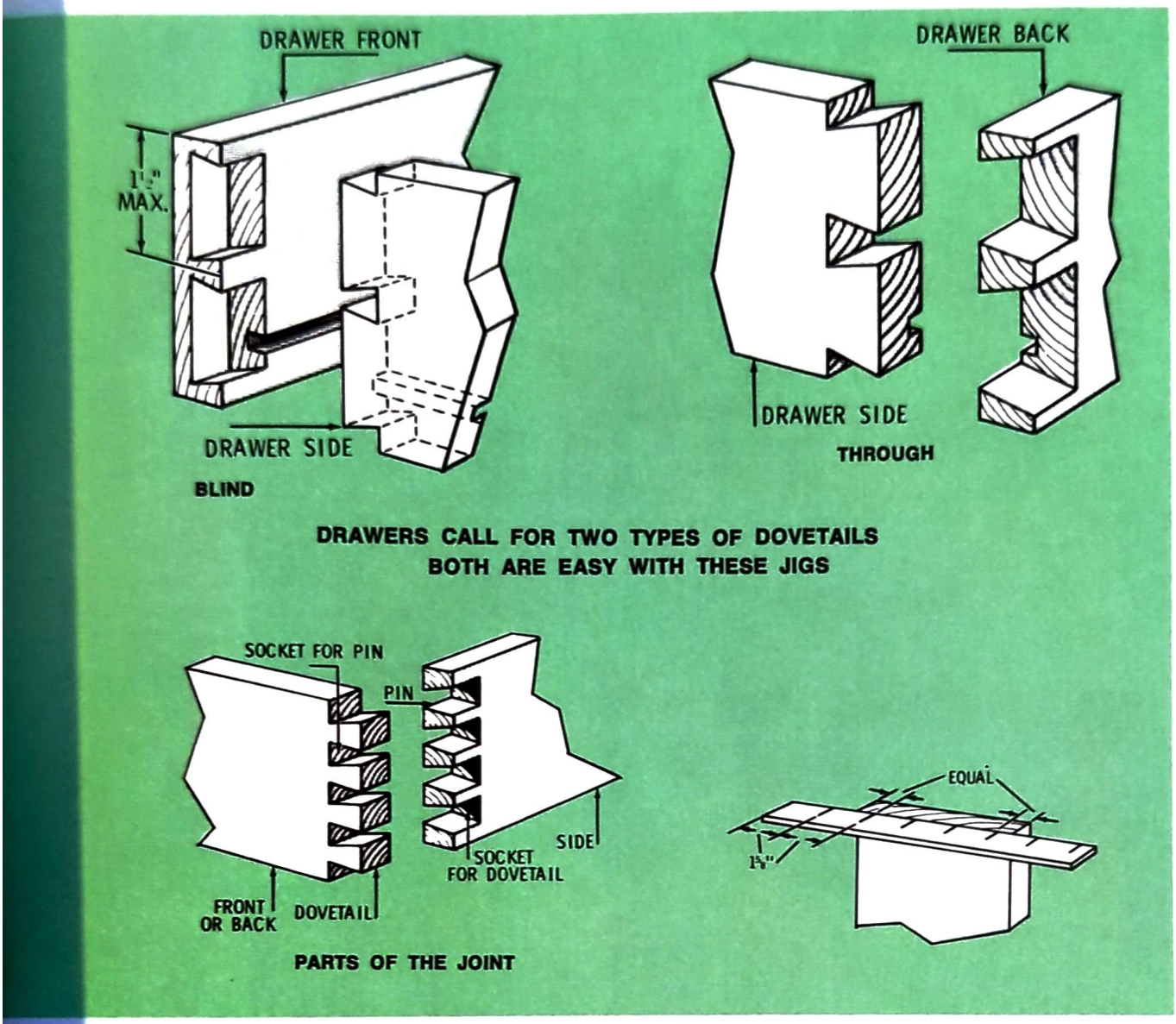
BY BRUCE BURK

Even the amateur woodworker can give drawers the mark of fine craftsmanship without fussy cutting with a handsaw

THERE'S NO DENYING that dovetail joints are the hallmark of fine cabinetwork—and the best joints for drawers and other box-frame assemblies that must withstand the stresses of everyday use. They are also among the handsomest of joints, so it seems a little ironical that they are usually tucked away out of sight except in reproductions of old pieces where authenticity and tradition require that dovetail joinery be exposed. In fact, the whole *purpose* of a blind dovetail is to be invisible when the drawer is closed.

Maybe that's why many amateur craftsmen shy away from the fine art of dovetailing. They figure that it's not a skill worth the time it would take

downspouts: see gutters



To locate pin sockets, lay off strip of wood with marks spaced 1⅝ in. apart. Clamp this strip against face of the front or back member, centering maximum number of marks, as sketched above. Transfer these marks to the stock, then scribe them across end with trysquare. These are centerlines of pin sockets, to let you line up template slots of the jig shown on the opposite page

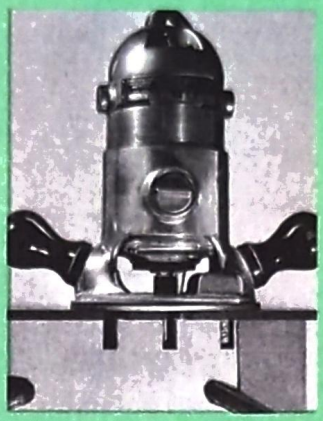
to acquire it, since the results too often can't even be seen.

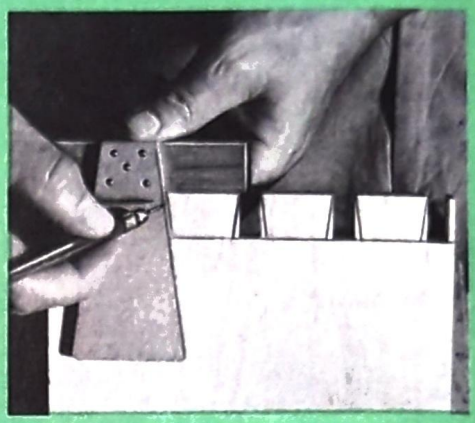
So if they use such joints at all, they are likely to settle for the dovetail jig and hand router commonly used by craftsmen. True enough, such jigs produce strong joints, but they can't turn out authentic *through* dovetails, or the neat, wide half-blinds that are used on the drawers of fine old furniture. These prize joints always have been, and probably always will be, a job that has to be done by hand.

But the easily made jigs detailed on the following pages spare you the chores of tricky layout and fussy cutting with a handsaw. And you don't have to invest in any extra equipment—not even in a special dovetail bit.

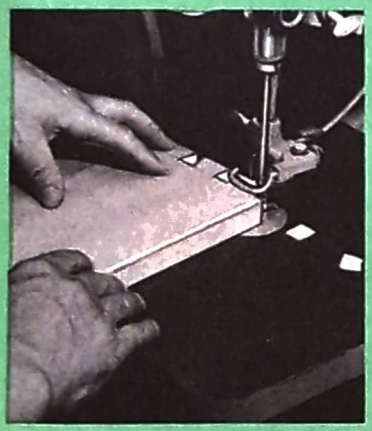
The router templates clamp on the work as shown in the illustration on the opposite page. There's one for cutting both types of drawer dovetails shown above (assembled) and below (separated). These dovetails are wider than those you may be accustomed to. Centerlines of

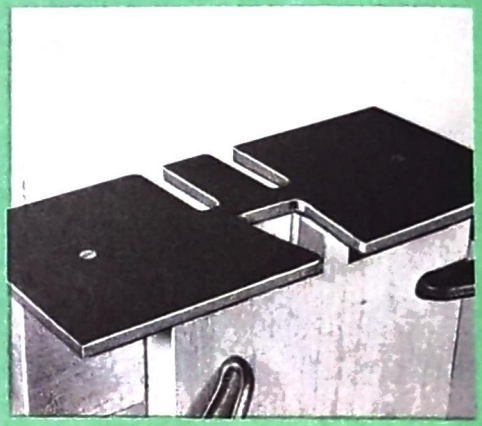
HOW TO USE THE THROUGH-DOVETAIL JIG



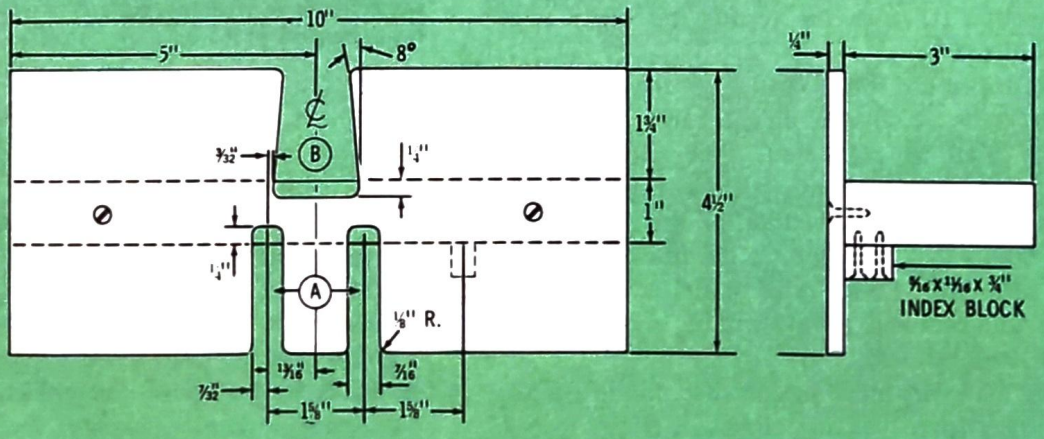


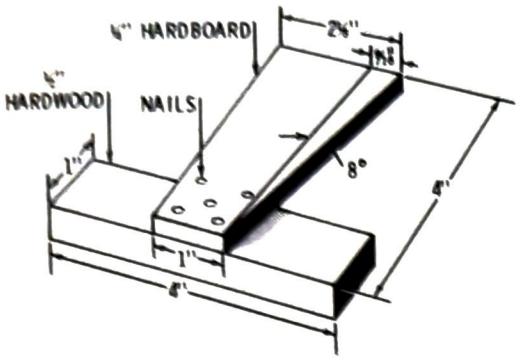
Center right-hand Cutout A (see plan sketch below) over pin-socket center line, and anchor with two C-clamps (left). Rout the first socket, then shift jig to insert index block in cut (center) and rout the next two sockets. Proceed this way across stock; when all are routed, lay out dovetail shapes with T-square jig (right)





Complete dovetails on jig saw (left) or bandsaw, by trimming small wedges off each side of the pin socket. Lay the dovetailed edge over the end of the side member and outline dovetail sockets with a sharp pencil (center). Align Cutout B with marks, clamp jig, and rout (right), then move jig on to the next position and rout again





the pin sockets can be up to 2 in. apart, depending on the height of the drawer.

Sockets that are wider than the template cutouts must be cut with *two* positionings of the jig, left and right.

The second jig is for cutting multiple through dovetails of the type sketched, bottom left, above. The end-grain will show on both dovetails and pins when this "through" joint is assembled. When sanded smooth and flush it makes a very decorative corner treatment for chests, dough-box reproductions and other small pieces.

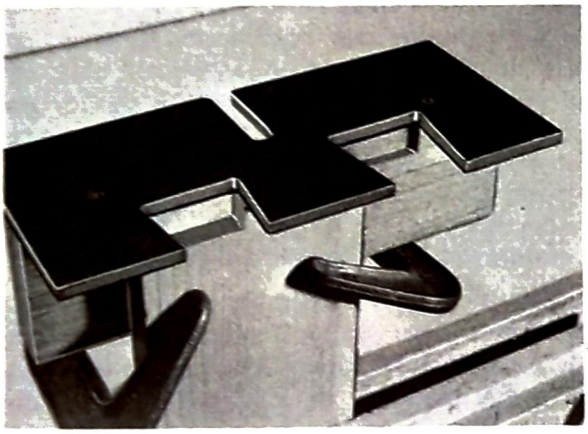
This jig, or some variation of it, would also be helpful in cutting *single* through dovetails, when assembling frames where extra strength is essential or desirable.

Both jigs are designed for use with a 7/16-in.-diameter router template guide and a standard 5/16-in. router bit. This combination makes a cut 1/16 in. *inside* the template outlines.

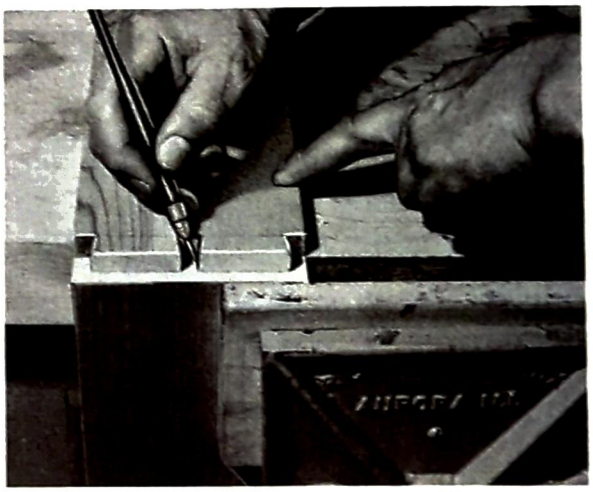
If you make the little layout T-square first, you can use it for establishing the dovetail angles on the jigs.

Once you have cut your front, back and side drawer members to the specified size—making certain that all end cuts are square—you are ready to put the jigs to work, as demonstrated in the step-by-step illustrations on the opposite page. You start by cutting pin sockets on both ends of two drawer members.

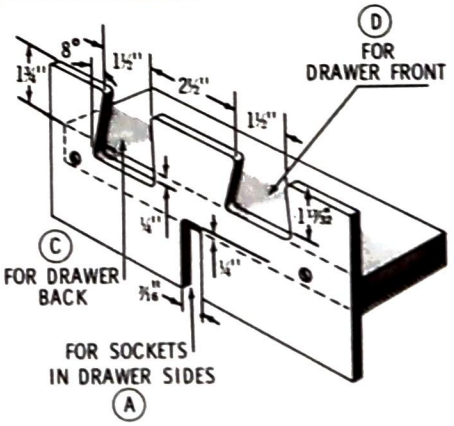
BLIND DOVETAILING



Wider drawer dovetails take a special jig. Here it's positioned for cutting blind sockets in front member. Align Cutout D with dovetail outlines (sketch right)



Cut and outline wide, blind dovetails in same steps shown on facing page—except that dovetails at end of slide are shorter than front member is thick



Drawer jig is assembled like first one, but has cutouts of different depths to handle blind dovetails on drawer fronts and through ones on drawer backs. Cutout C laps into hardwood, as does A

perfect dovetailing, continued

With the multiple through dovetail jig, you first establish the socket centerlines at intervals of 1⅝ in. The easiest way to do this is illustrated in the sketch on page 809, bottom right.

Then you adjust your router depth-of-cut to 1/64 in. greater than the combined thickness of the side member and template hardboard.

After the pin-socket *slots* are cut, it's a simple matter to trim back each side at an 8-deg. angle to form the dovetails between.

(You could save yourself this step by using a tapered dovetail bit, but most of the commercial types available are too short and have too steep a taper for this use.)

The completed front or back member now becomes the layout template for marking the dovetail sockets on the end grain of the side member. Because of possible discrepancies in cutting, it's always best to mark from the set of dovetails that will eventually be glued into the sockets you're marking—don't mix pieces end for end.

If you have cut the template correctly, cutout B on the pattern, shown on page 810, should match the end-grain outlines, fitting 1/16 in. outside the lines.

Clamp the jig in place, routing the dovetail sockets one by one, with the bit at the same setting that you have already used for the slots of the pin sockets.

With the drawer jig, the procedure is nearly identical. It's designed for use with standard drawer stock, where the front is usually 1-in. lumber (actual thickness: ¾ to 13/16 in.) and where sides and back normally are ½ in. thick. Since the dovetails on the front end of the side member normally pass more than halfway through the front member, you must determine the depth of the pin sockets by a special step.

how to do it

Before you begin actual work be sure any edge tools you will use, including the router bit, are razor-sharp. Sharp tools are essential to good work, and dovetailing by the method described is no exception. Take time to rough-grind, oilstone and hone the cutting edges so that they cut freely as otherwise you will have trouble producing the clean cuts required.

Clamp a scrap piece, the same thickness as your front member, vertically in the vise and clamp the jig over the end. Using Cutout D (shown on page 811) and an estimated bit setting, make a sample socket in the scrap, as shown in the lower right photo on page 810. Now, detach the jig and lay the scrap flat on your work bench, socket up.

Rest your router on the face, with the bit extending alongside the socket, and adjust the depth-of-cut to the depth of this socket plus the thickness of the hardboard template. This will be the proper depth for the pin sockets in the side members.

Mark the center lines for these sockets and cut the slots for them. Since there are fewer of them involved and their spacing may vary, this jig provides only one slot and dispenses with the index block. All you have to do is simply center Cutout A over each center line scribed across the end grain of the side member.

Finish the shaping of the pin sockets on the jig saw, as before, after laying them out with the little T-square. Transfer the resulting dovetail pattern to the end of the front member and position Cutout D around these lines.

If the drawer side is to set flush with the end of the front member, set the router's depth-of-cut to the combined thickness of the side and template. If the drawer front is to be lipped, increase the depth-of-cut accordingly. After routing the dovetail sockets, sharpen the rounded corners with a small chisel.

Some shaving may be indicated by your first trial fitting. You don't, of course, assemble any of the joints until *all* dovetails and sockets are cut on both ends of each member. Then you carefully spread glue on all butting surfaces and slip the joint together.

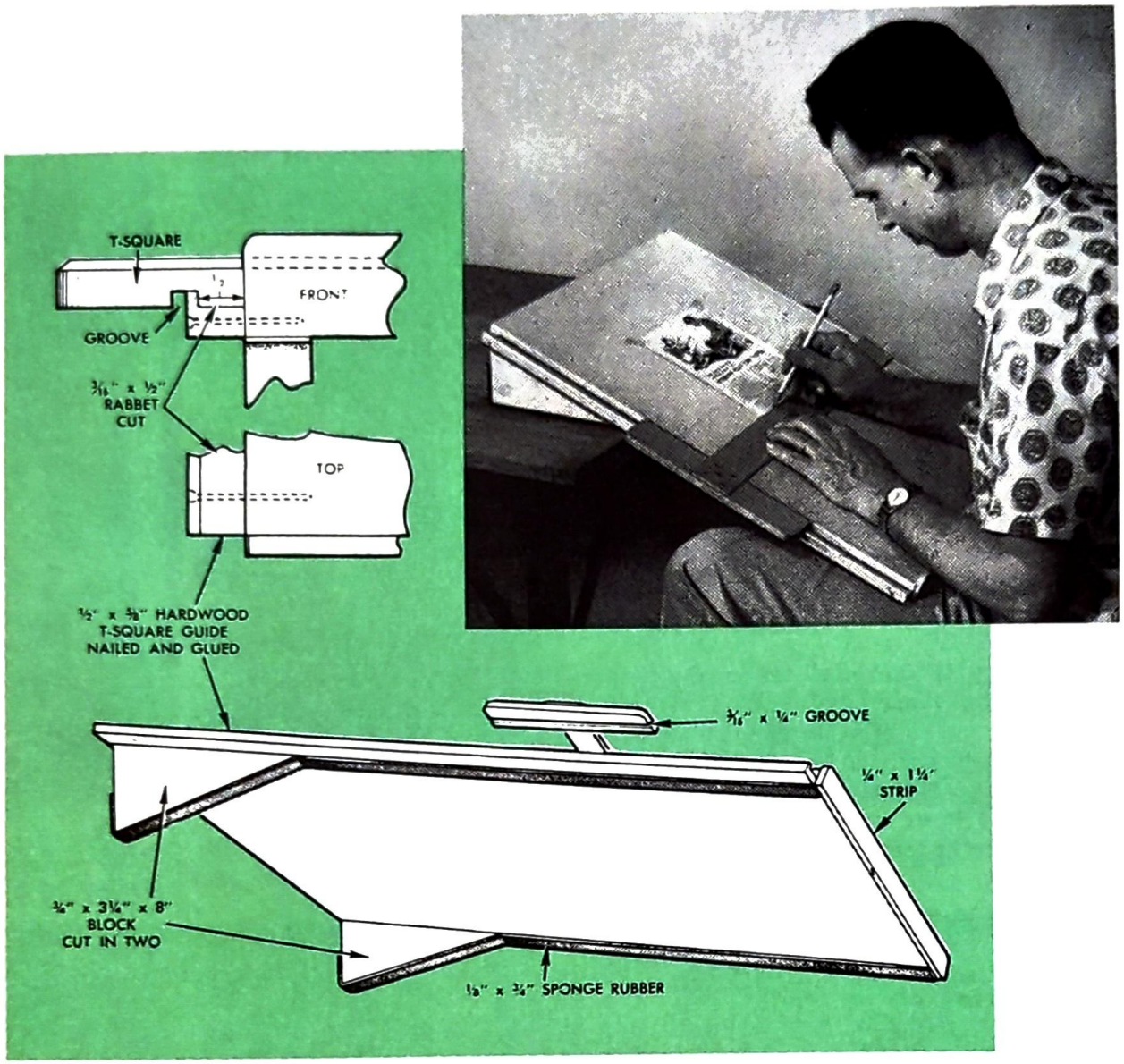
consider the stress

Just as you can assemble it only one way, there is only one way for it to break apart. Where the joint must withstand stress, be sure to design it so that the stress won't be applied in the direction of the assembly.

Look again at the sketches at the top of page 809. The stress of opening and closing the drawer would tend to separate the joint directly forward and backward, and this is impossible since the joint can only separate toward the side.

Stress is of less concern when assembling the multiple through dovetails of a piece of furniture, so the joint may be turned for its best decorative effect. Once you've sanded it down and applied a natural finish to emphasize the grain contrasts, you'll have a joint that echoes the golden years of fine hand cabinetmaking.

See also: moldings; routing.


T-SQUARE
FRONT
GROOVE
3/16" x 1/2" RABBET CUT
TOP
1/2" x 3/8" HARDWOOD T-SQUARE GUIDE NAILED AND GLUED
3/16" x 1/4" GROOVE
1/4" x 1 1/4" STRIP
3/4" x 3 1/4" x 8" BLOCK CUT IN TWO
1/8" x 3/4" SPONGE RUBBER

Lap board has T-square guide

BY ARTHUR W. ARNEMANN

ANY STANDARD DRAWING BOARD in the smaller sizes can be fitted with two nonslip triangular feet and a T-square guide and used as a lap board, as shown above. Note that the wood T-square head is grooved lengthwise ¼ x 3/16 in. to drop into a rabbeted strip attached to the long edge of the drawing board with nails and glue. A wood block of the dimensions given is cut diagonally and the pieces glued and nailed to the underside of the board at the forward end.

This arrangement is especially useful when the only table available is too high for comfortable use. Just rest the legs of the drawing board on the table, slip the T-square into the groove, and you are ready to draw.

See also: ellipsograph; tracing projector.

Stand-up drafting table

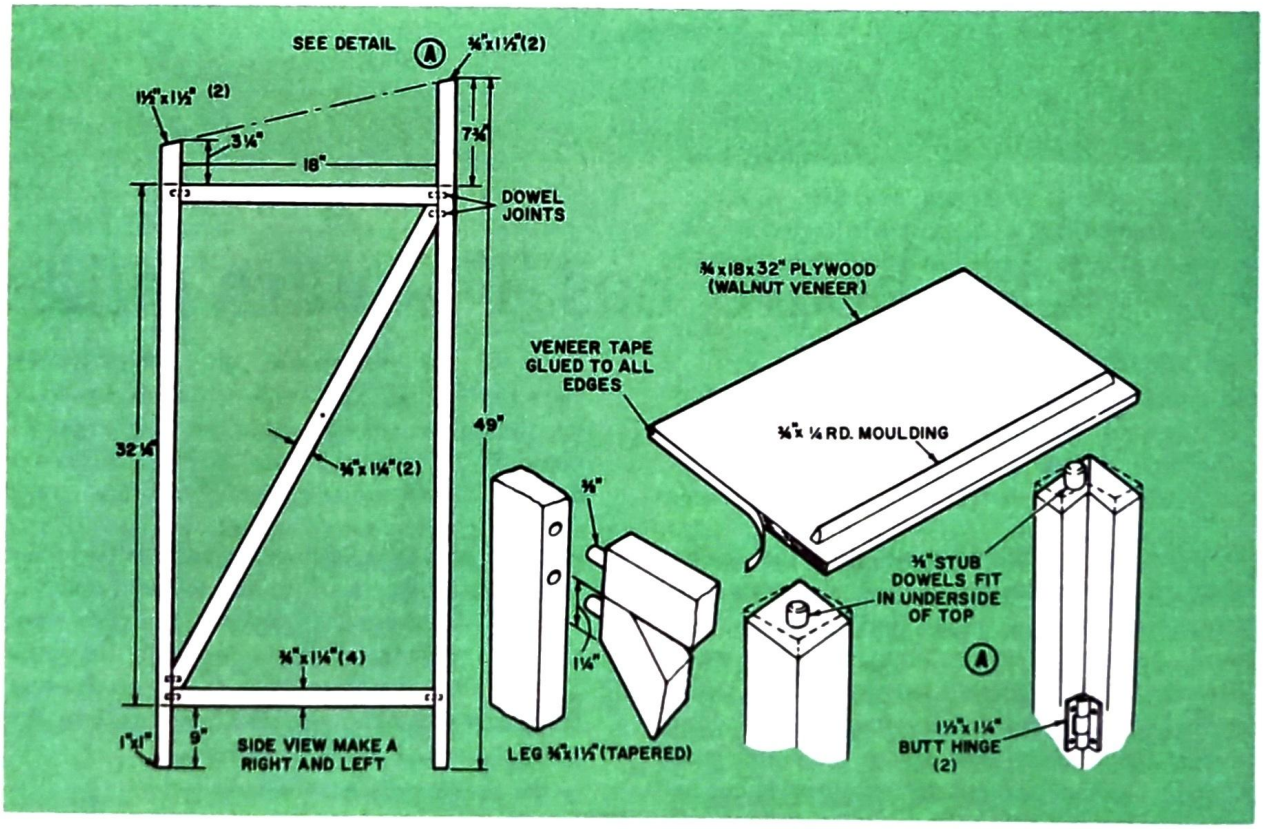
THINK BEST on your feet? Then this simple desk-drafting board, which sets up in a jiffy and stores in minimal space, is for you.

Make two of the frames shown below. The rear legs taper from 1½ in. square to 1 in. square, while each ¾ x 1½-in. section of the compound front leg is tapered to 1 in. across its bottom width. Each front-leg section is mitered along its length at 45 deg.

Bevel the tops of all legs 20 deg. toward the rear. Since the front leg must have that degree of bevel when opened to a right angle, cut a compound miter on each section, 45 deg. from the front corner.

In each leg top, drill a hole and insert a ⅜-in. dowel, leaving ⅜ in. projecting. Drill three 7/16-in. holes in the underside of the plywood top near the lower corners and upper edge at the center.

Apply veneer tape to the edges; glue on a 31-in. length of ¾-in. beveled-end, quarter-round molding ½ in. up from the bottom edge.



1

Perspective T-square

THE IMPRACTICALITY of working from vanishing points some 6 ft. beyond the edges of the board has led many artists to make perspective drawings by eye. Some have become good at it, but the eye method is inaccurate. Now, thanks to a curved-head T-square, off-the-board vanishing points can be brought to within the convenient working surface of the average-size drawing board, making third-dimensional perspective drawing easy. This simple answer was developed by veteran artist Arthur Bargquist.

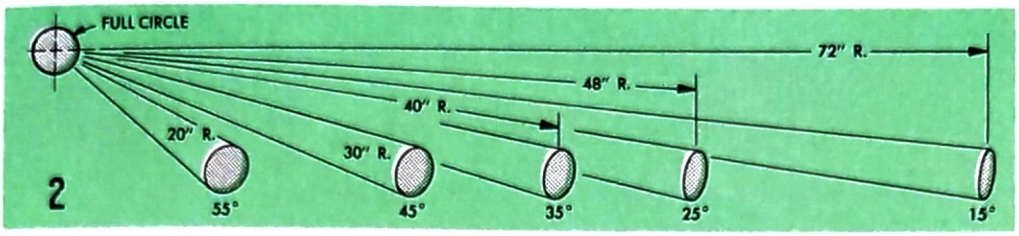
The perspective T-square differs from a regular one in that it has interchangeable curved heads, each with two radii for making drawings at different angles and different planes. As shown in Fig. 1, the curved head rides against two guide pins on each side of the drawing. The side of the curved head on which the pins are located is determined by the angle for your drawing.

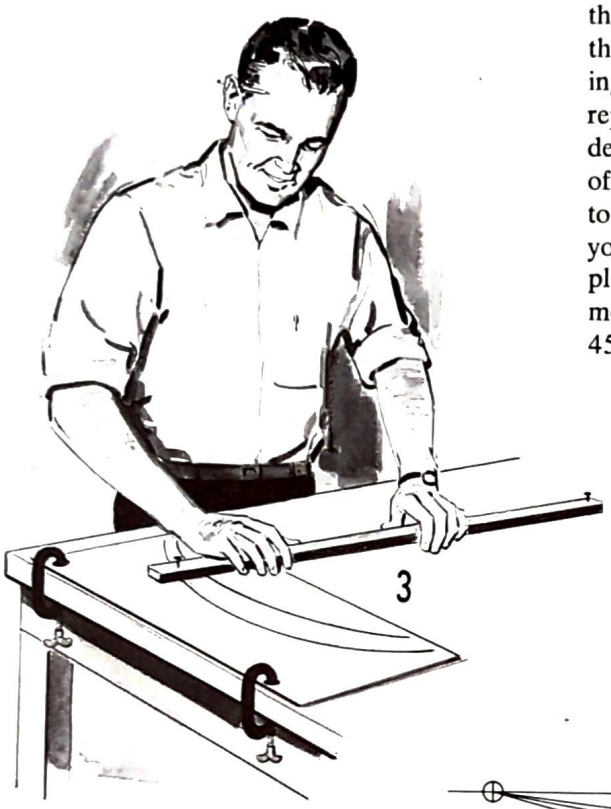
Fig. 2 shows how angle of view decreases as distance from the vanishing point increases. The radius of the curved head is chosen accordingly; with the interchangeable heads detailed in Fig. 6, you can choose one of four radii—30, 40, 48 and 72 in.

Figs. 4 and 5 show how you determine the location of the guide pins. In both examples, an eye level or horizon line is established by drawing a horizontal line across the drawing.

This is an arbitrary line drawn at a point on the drawing which suits the eye level at which you want to view the object being drawn. The selection of the curved head is made consistent with the desired view; the beam of the perspective T-square is aligned with the eye-level line, and two push pins are stuck in the board against

drainage: see landscaping

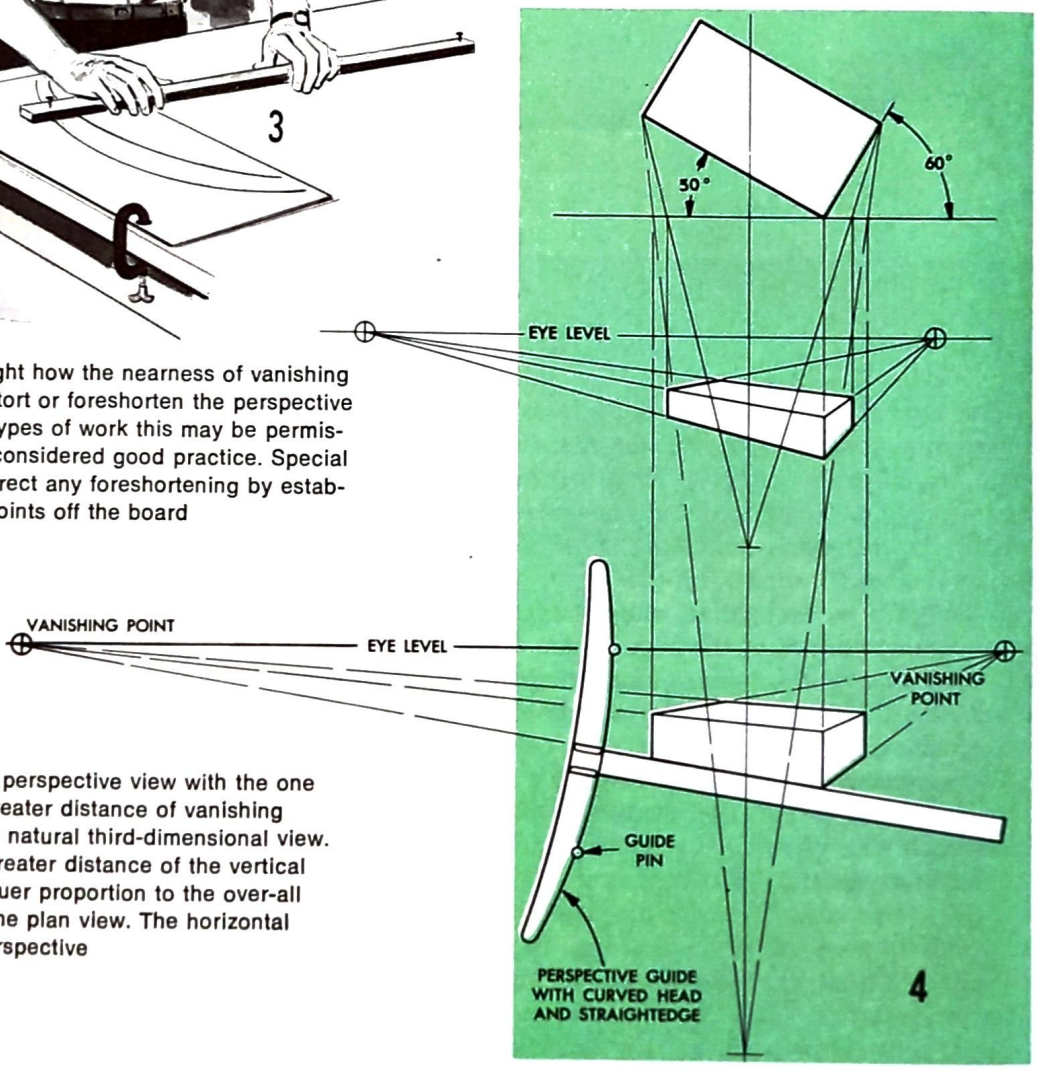




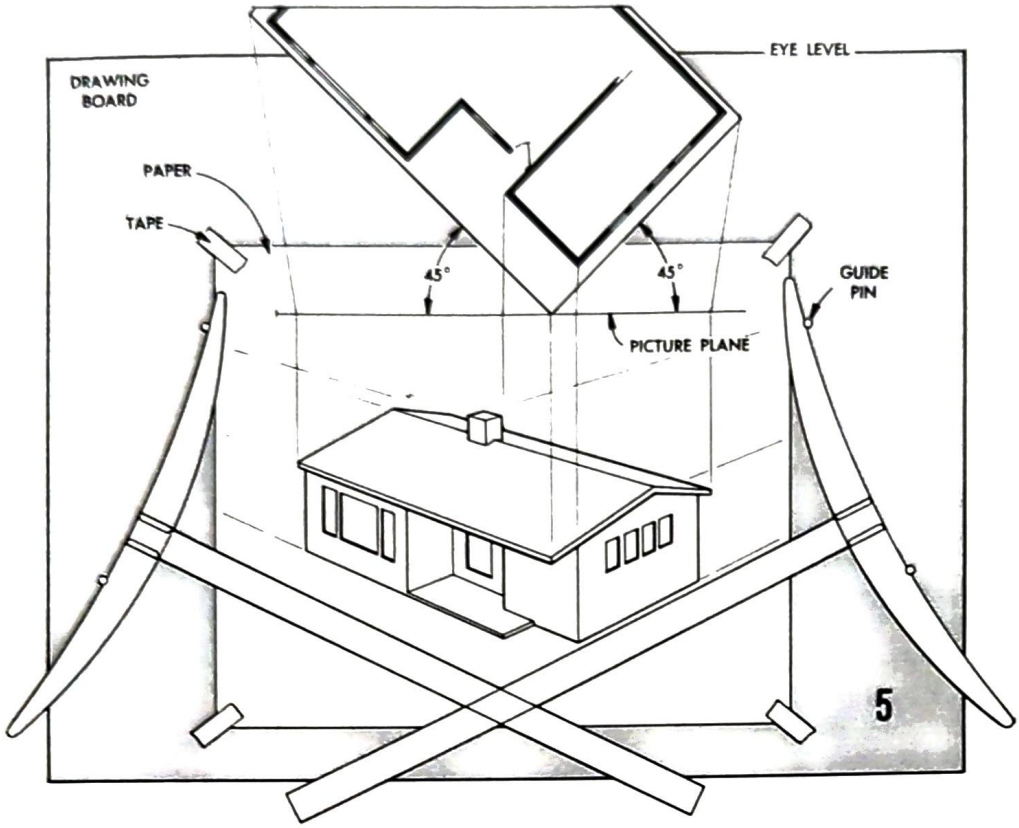
Note in detail at right how the nearness of vanishing points tends to distort or foreshorten the perspective drawing. In some types of work this may be permissible, but it is not considered good practice. Special T-square helps correct any foreshortening by establishing vanishing points off the board

the proper edge of the curved head. To locate the guide pins on the opposite side of the drawing, the T-square is turned over and the step repeated. From here correct proportions are determined by placing the plan view at the top of the drawing in the usual way and at an angle to fit the amount of front and side of the object you wish to see. In Fig. 4, you'll see that the plan drawing is placed at a 15-deg. angle, giving more front than side view; in Fig. 5 it is at a 45-deg. angle, giving an equal view.

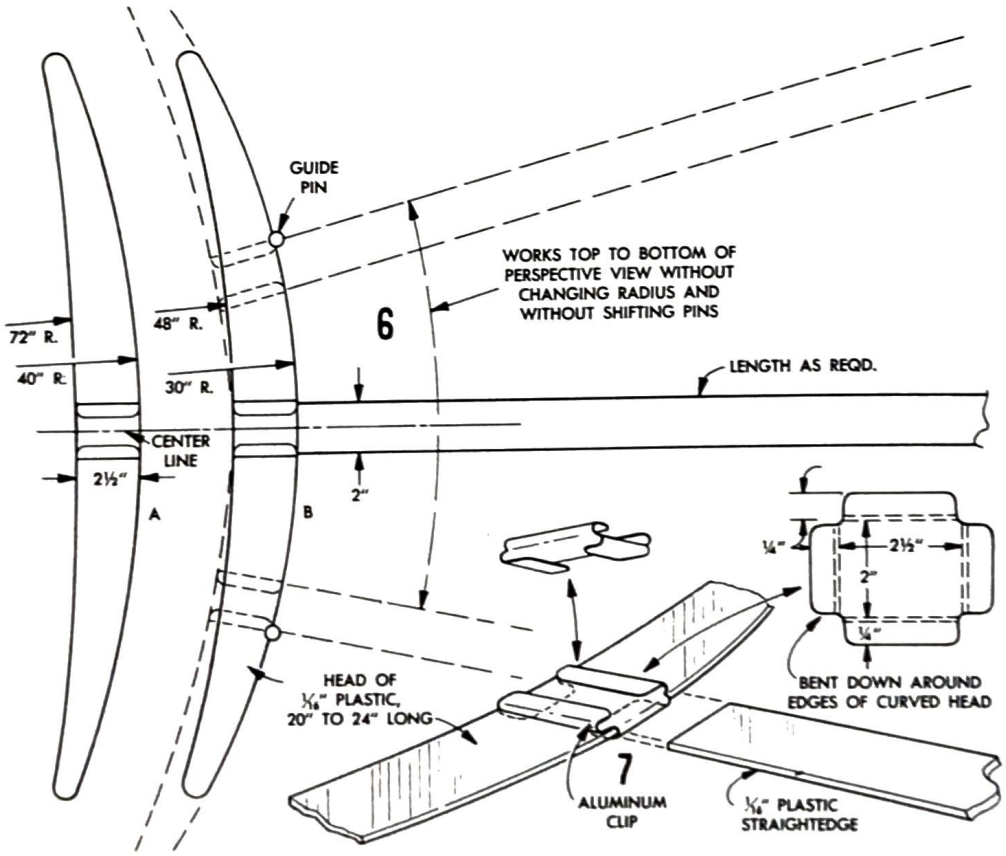
Use either 1/16 or 1/8-in. clear plastic to make



Compare the lower perspective view with the one above. Note how greater distance of vanishing points gives a more natural third-dimensional view. See also how the greater distance of the vertical viewpoint gives a truer proportion to the over-all size and shape of the plan view. The horizontal lines are in true perspective



your perspective T-square. Scribing the material for the curved heads is done as in Fig. 3. The sheet plastic is clamped to a flat surface, and a stick with a nail in each end serves as a beam compass. The distance of the nails center to center should equal the desired radius. Cut out the curved heads on the scribed lines and smooth the rough edges. Fig. 7 shows how a clip of sheet aluminum, affixed to each curved head, lets you mount either head on the beam.



How to clear a clogged drain

By W. CLYDE LAMMEY

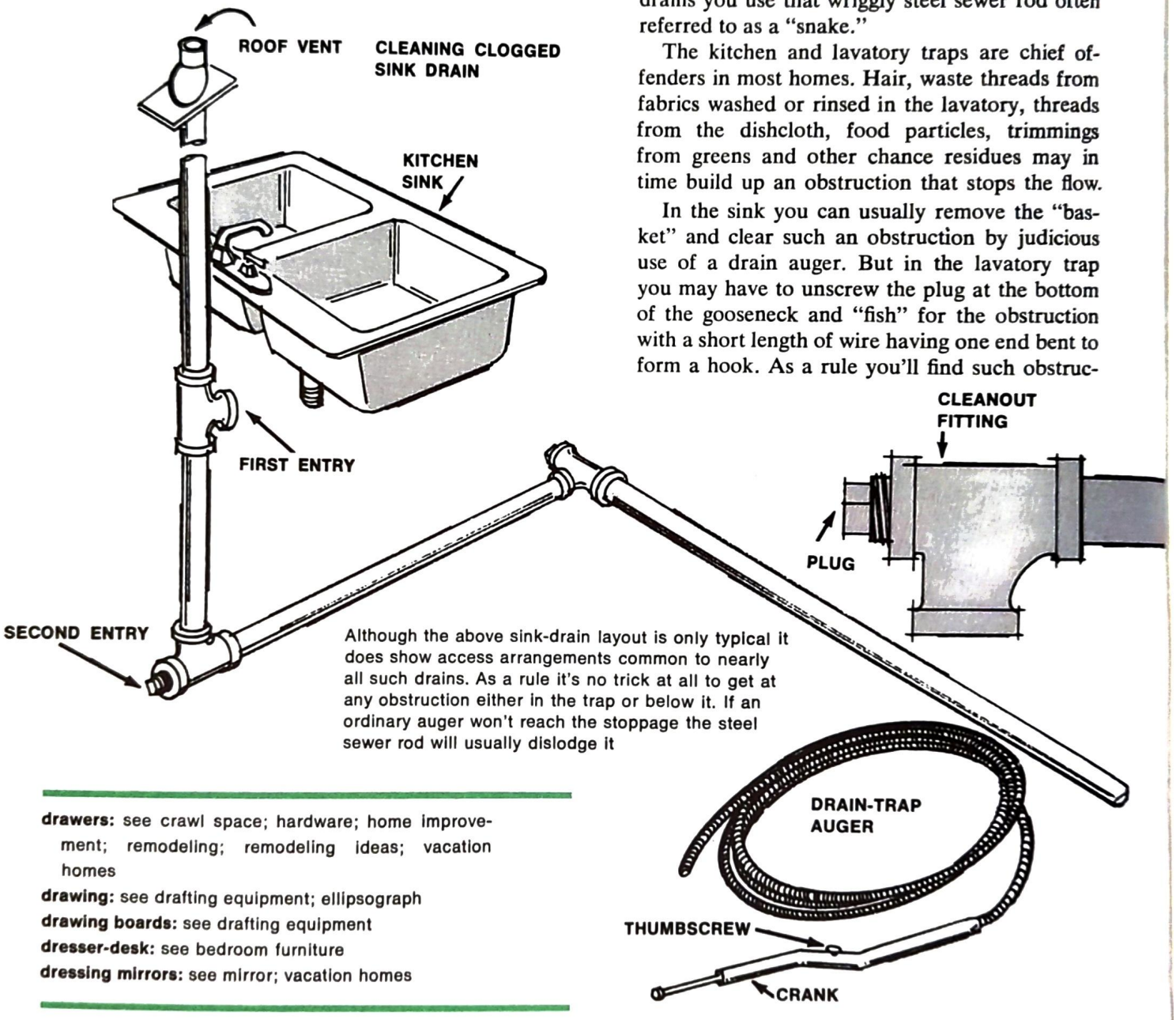
Unstopping drains may be out of your "line" but you can save dollars learning how. Here are some pointers

WHEN HOUSEHOLD DRAINS become clogged, often without much warning, you generally can't put off unclogging until tomorrow.

Just knowing what to do usually has the problem half licked before you start. Most ordinary stoppages can be cleared with that broomstick-and-suction-cup affair known as a "plumber's helper," or perhaps a drain-trap auger. For long drains you use that wriggly steel sewer rod often referred to as a "snake."

The kitchen and lavatory traps are chief offenders in most homes. Hair, waste threads from fabrics washed or rinsed in the lavatory, threads from the dishcloth, food particles, trimmings from greens and other chance residues may in time build up an obstruction that stops the flow.

In the sink you can usually remove the "basket" and clear such an obstruction by judicious use of a drain auger. But in the lavatory trap you may have to unscrew the plug at the bottom of the gooseneck and "fish" for the obstruction with a short length of wire having one end bent to form a hook. As a rule you'll find such obstruc-



Although the above sink-drain layout is only typical it does show access arrangements common to nearly all such drains. As a rule it's no trick at all to get at any obstruction either in the trap or below it. If an ordinary auger won't reach the stoppage the steel sewer rod will usually dislodge it

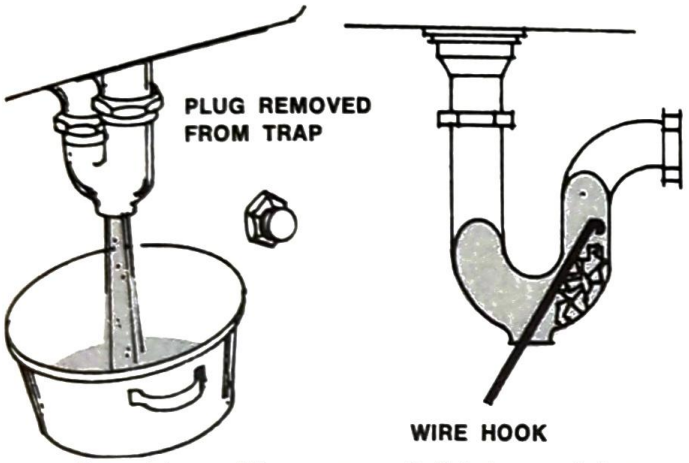
drawers: see crawl space; hardware; home improvement; remodeling; remodeling ideas; vacation homes
drawing: see drafting equipment; ellipsograph
drawing boards: see drafting equipment
dresser-desk: see bedroom furniture
dressing mirrors: see mirror; vacation homes

tions on the "up" side of the bend where they are easily reached with the hook end of the wire. Have a utensil handy to catch dirty water and gunk. Be careful not to damage the threads that take the plug, or cap, and don't forget to coat the threads of the plug with pipe compound before you replace it. Otherwise the trap may leak.

Toilet stoppages are usually easy to break with an auger, unless, of course, some hard object such as a small toy has been dropped into the bowl and lodged just out of reach. If you have reason to suspect this, don't use the auger. Rather dip the water out of the bowl and try for the obstruction with the hand.

Caution: Don't force your hand or finger into any opening in the bowl. You may have trouble withdrawing it!

If you can't reach the obstruction then try for it with a stiff wire having one end bent to a hook shape. Bend the wire as you go so it will take the curve of the bowl. Work carefully, changing the shape of the hook if the first try doesn't do it.



If careful use of the auger won't dislodge an obstruction in the trap try a piece of heavy wire with one end bent to a hook-shape. Much the same procedure can be used when clearing a toilet bowl

Partial stoppage of toilet bowls, resulting in sluggish flushing, may also be caused by the slow buildup of lime deposits from "hard" water. Usually these can be loosened with a short-bladed knife.

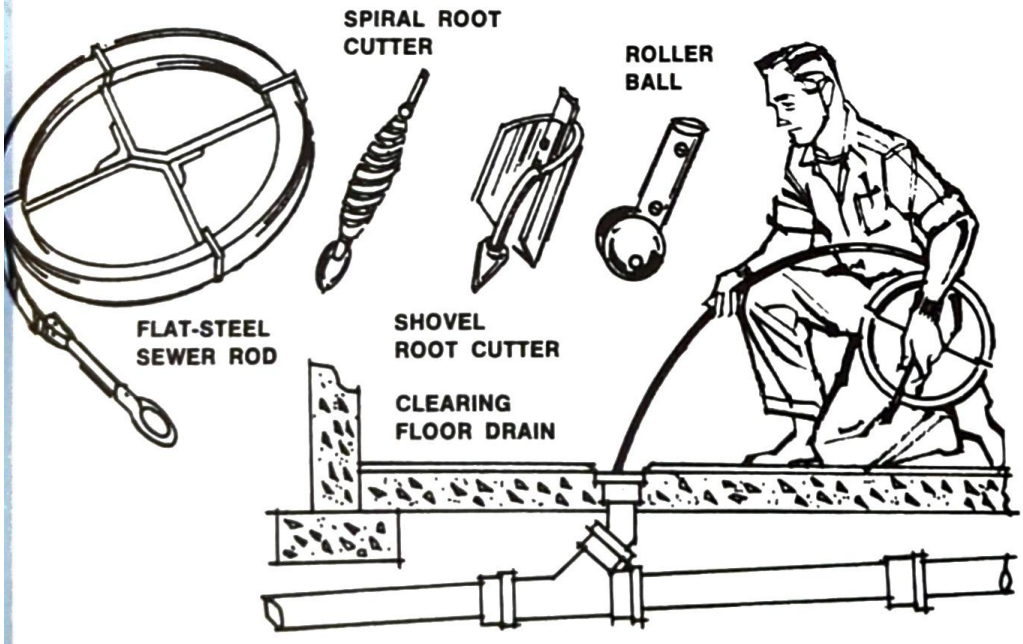
The "clog" in a basement drain can be anywhere between the floor inlet and the street but as a rule it will be under the floor or near the floor inlet if the drain is trapped; unless, of course, there are tree roots in the drain tile out near the curb. Then you'll need professional help.

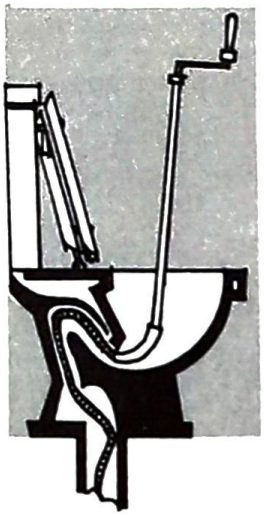
Otherwise you go into the drain at the floor inlet with your steel "ribbon." Don't be discouraged if at the first few tries the ribbon kinks or winds up into a ball and refuses to go farther. Pull it back part way to unkink it and keep right on probing for that weak spot. If you persist you'll hit it sooner or later. Then the free end will pop through and away goes any water that may have seeped onto the floor.

Whenever you clear a drain, flush it out with clean water to get rid of any debris remaining. Use degradable detergents.

There are several prepared chemical aids for clearing drains. Most of these contain caustics and you should read the warnings and instructions on the container closely before using.

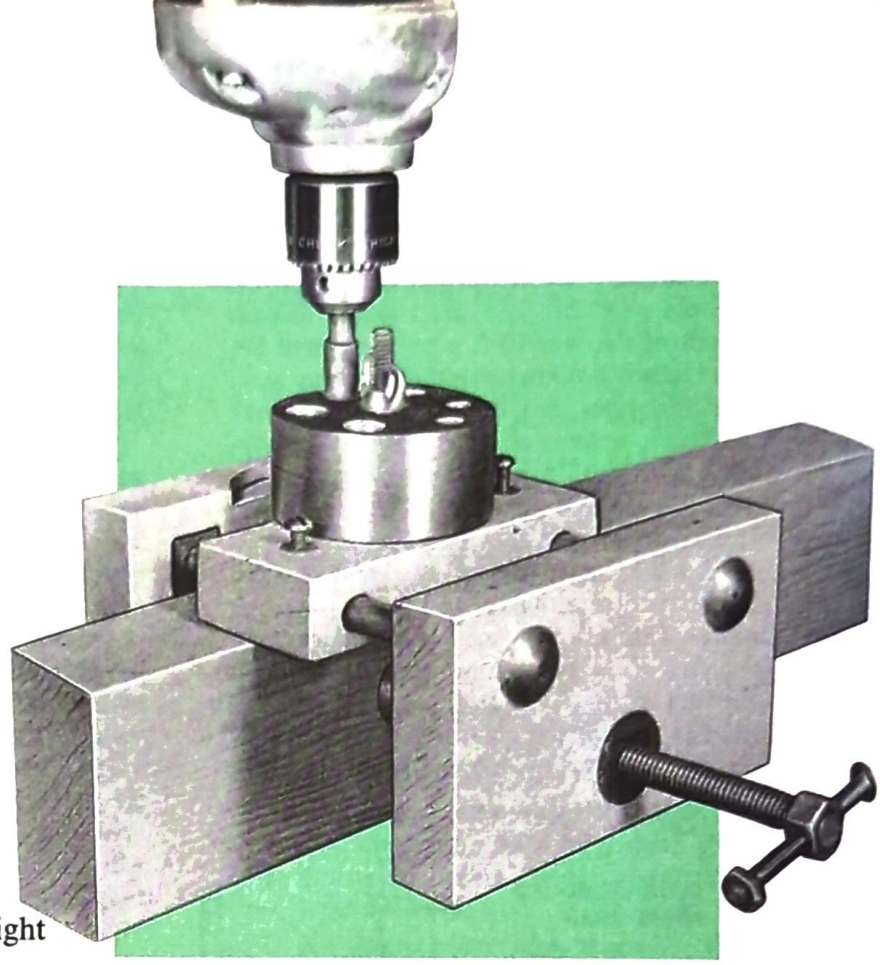
See also: bathrooms; faucets; kitchens; plumbing; septic systems





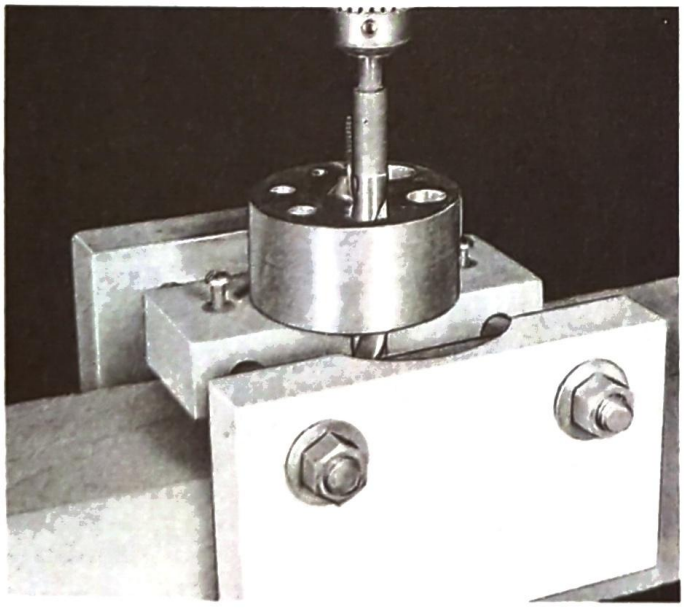
Jig for precision drilling

By EMIL P. KUSHNER



The turret revolves,
the platform slides,
the pressure screw clamps tight
on any stock up to 4 in. thick

The drill bit is inserted in the hole of matching diameter, which has been positioned so that the bit will clear the edge of the sliding bar and center over the layout mark on the work

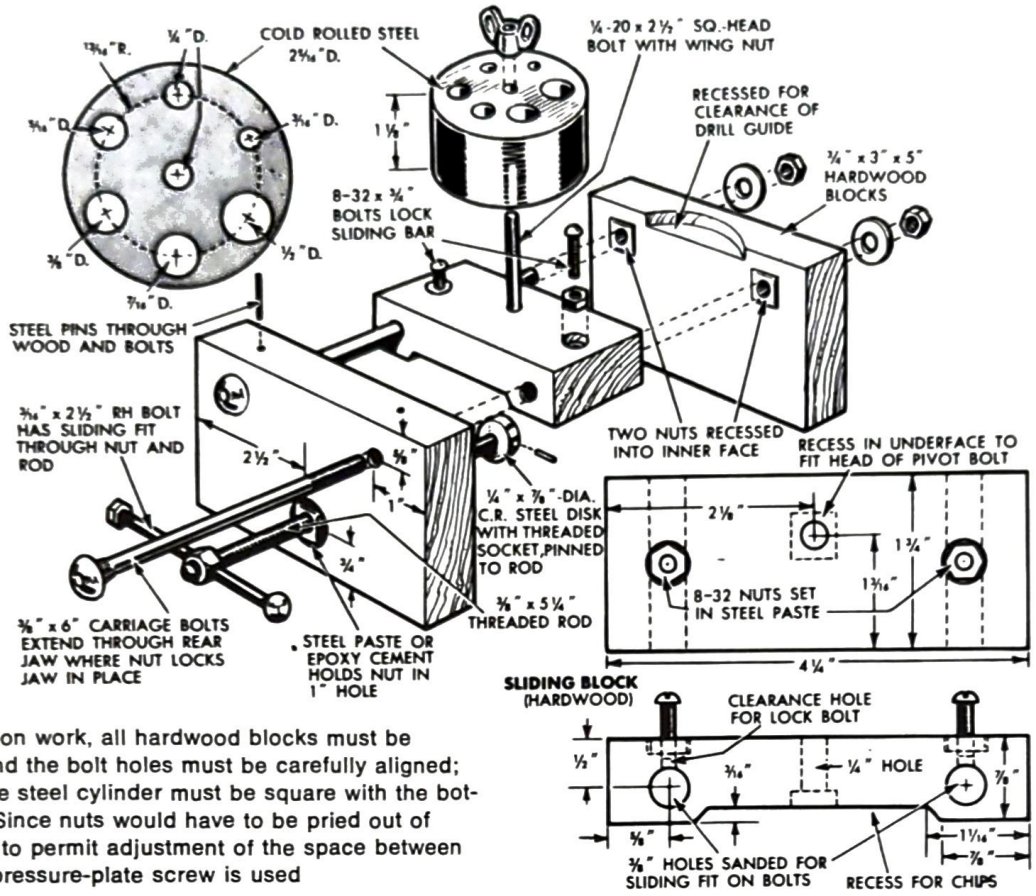


ASSEMBLE THREE hardwood blocks and a steel cylinder with a few bolts, and you'll end the grief of trying to drill true holes at precise spots. Two of the blocks position the jig on the work with a vise-jaw action. The third serves as a sliding platform for further adjustment of the rotating cylinder, which is pre-drilled to offer a choice of guide holes for bits of six diameters.

The jig is especially handy when drilling holes for dowel joints with a hand brace or portable electric drill. Such holes, and bolt holes in critical assemblies, must be in perfect alignment and at exact right angles to the edges joined.

Cut the vise-jaw blocks, brad them face-to-face temporarily and drill ⅜-in. holes for the carriage bolts through both at once. Separate the blocks, drill the 1-in. hole to recess the nut, then, using the same center, drill a ⅜-in. hole on through the block to pass the tightening screw. Place the nut in the recess and pack steel paste or epoxy around it to fill the hole flush. Before this sets, thread the rod into the nut and through to the block, to assure alignment.

In the corresponding face of the second block, chisel two square recesses around the holes, deep enough to seat the nuts you'll use on the carriage


COLD ROLLED STEEL
¼ "D.
¼-20 x 2½" SQ.-HEAD BOLT WITH WING NUT
RECESSED FOR CLEARANCE OF DRILL GUIDE
¾" x 3" x 5" HARDWOOD BLOCKS
8-32 x ¾" BOLTS LOCK SLIDING BAR
STEEL PINS THROUGH WOOD AND BOLTS
⅜" x 2½" RH BOLT HAS SLIDING FIT THROUGH NUT AND ROD
TWO NUTS RECESSED INTO INNER FACE
RECESS IN UNDERFACE TO FIT HEAD OF PIVOT BOLT
¼" x ⅜"-DIA. C.R. STEEL DISK WITH THREADED SOCKET, PINNED TO ROD
⅜" x 5¼" THREADED ROD
8-32 NUTS SET IN STEEL PASTE
⅜" x 6" CARRIAGE BOLTS EXTEND THROUGH REAR JAW WHERE NUT LOCKS JAW IN PLACE
STEEL PASTE OR EPOXY CEMENT HOLDS NUT IN 1" HOLE
SLIDING BLOCK (HARDWOOD)
CLEARANCE HOLE FOR LOCK BOLT
¼" HOLE
⅜" HOLES SANDED FOR SLIDING FIT ON BOLTS
RECESS FOR CHIPS

For precision work, all hardwood blocks must be squared and the bolt holes must be carefully aligned; holes in the steel cylinder must be square with the bottom face. Since nuts would have to be pried out of rear block to permit adjustment of the space between the jaws, pressure-plate screw is used

bolts. These are held in place by press-fit.

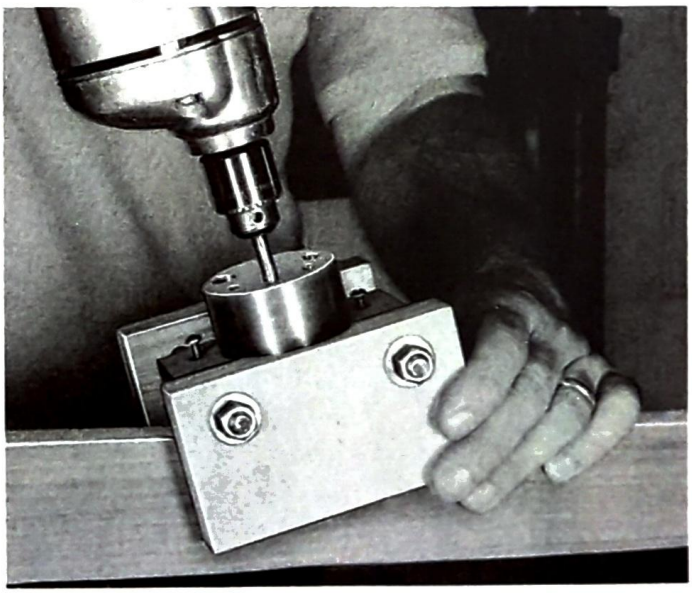
Now, using either jaw block as a template, drill the carriage-bolt holes through the edges of the sliding hardwood block. Wrap sandpaper around a ¼-in. dowel and relieve these holes enough to provide a sliding fit on the bolts. Cut the chip recess in the undersurface, then drill the ¼-in. hole for the square-head bolt, and chisel a square recess for its head. Drill the holes for the locking bolts and counterbore to recess their nuts, which also are anchored in steel paste.

Drive the carriage bolts through the front jaw-block, ending with a sharp blow to sink the square shoulder into the wood. Drill holes down through the bolts from the top edge, to take steel pins. Slide the platform block onto these bolts, then turn on two square nuts before sliding on the rear jaw. Adjust the nuts until the two jaws are parallel when the nuts are snug.

After bolting the steel guide to the sliding block, mark the upper edge of the rear block for cutting the circular gain. This allows the cylinder to lap the jaw when you're drilling small holes in narrow stock, with the jig compressed.

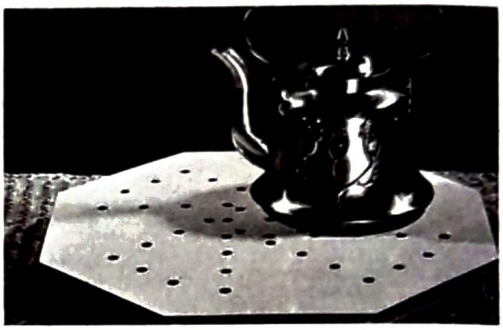
See also: lathe techniques; punch; woodworking.

Angle drilling is done by tilting the jig until the jaw ends are in alignment with the sliding T-bevel set for the desired angle. Clamp the jig tight and hold it steady while drilling



Design drilling with perforated hardboard

By WALTER E. BURTON



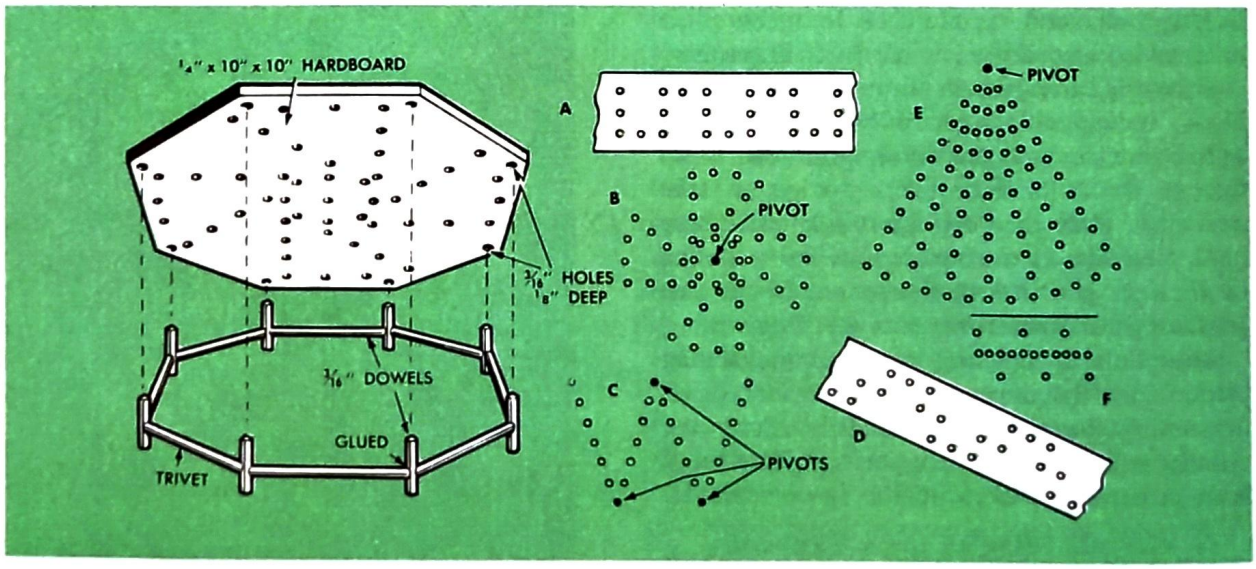
The perforated hardboard template must be clamped so it cannot shift while each set of holes is drilled

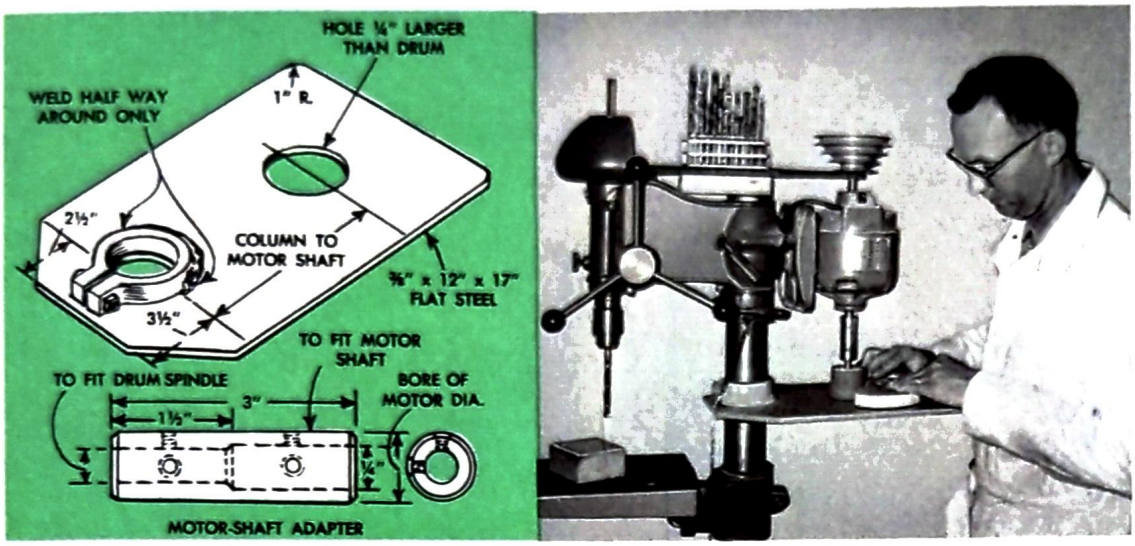
WITH ITS PRECISE, uniformly spaced rows of holes, perforated hardboard provides a ready-made template for drilling a variety of decorative geometrical designs in plywood, sheet aluminum and similar panel materials. Such decorative drilling can be used for embellishing cabinet doors, trivets, trays, hot-dish pads, table tops, wall panels, screens, picture frames, shutters and so on. The drilled holes themselves can form the decorative design, or they may be filled with dowels or a plastic material for an inlaid effect.

To develop a design with the aid of a hardboard template, you either can use certain holes in a fixed template, patterns A, D and F below, or vary the patterns by rotating the template to successive positions around a fixed peg, designs B and E. You may vary the pattern still further by shifting the template laterally or changing the angle, pattern C. It is best to work out the design on paper before you begin to drill.

Use a drill bit the size of the holes in the hardboard template. If your design requires pivoting the template on a peg, drill the hole for the dowel first. Clamp the template so it cannot shift while you drill each set of holes. After drilling the second hole insert another dowel to serve as an extra guard against shifting, regardless of how many clamps are used.

When most materials are drilled, burrs form around the holes. You can remove these by sanding the panel surface or by touching up each hole with a countersink.





Extra duty from a drill press

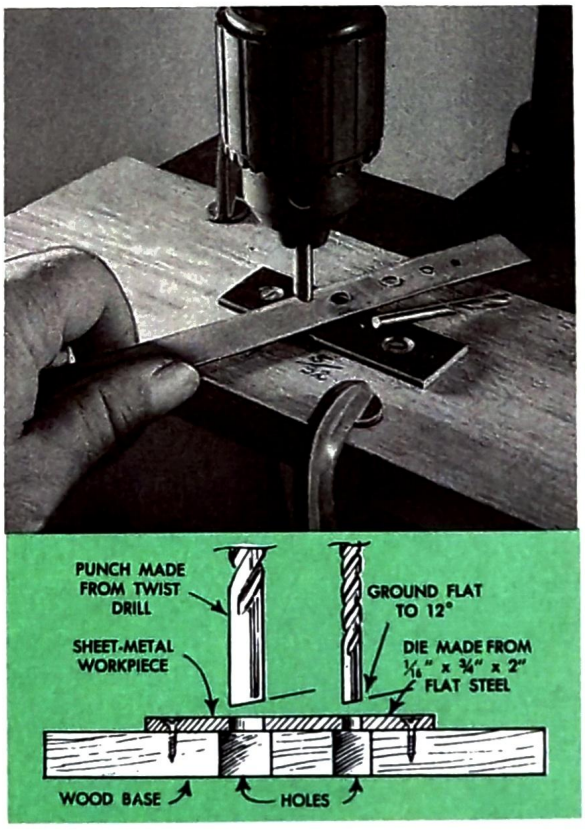
spindle sander

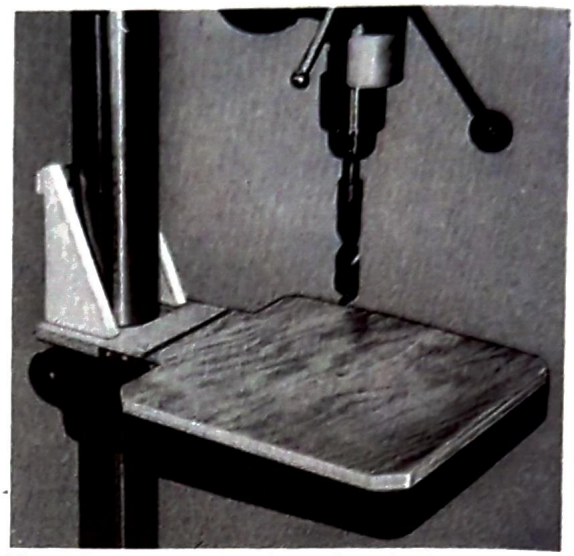
IF YOUR DRILL-PRESS motor has a double shaft, you can add this handy spindle sander simply by making an adapter from 1 or 1¼-in.-round steel and fitting a sanding table on the drill-press column as pictured. The table clamps to the column, permitting it to be moved up or down to utilize all the abrasive surface of the drum. Holes for the column and drum can be flame-cut at a local welding shop. The hole for the drum should be about ¼ in. greater in diameter than that of the drum. Likely the same shop can make the clamp and weld it to the table at nominal cost. When tightened on the column the surface of the sanding table will always be at right angles to the spindle.

punch press

YOU CAN USE not only the drill press but the drill bit as well to punch holes in light sheet metals. Just grind the end of the drill-bit shank at an angle of about 12 deg. This serves as the punch. With the same bit, drill a hole through a piece of flat steel, drill and countersink two holes for screws, attach to a drilled block of hard wood and there's your die. This basic idea can be carried further by using a strip of tool steel ⅛ or ¼ in. thick and drilling a row of holes along a center line, each of a different diameter, to form a multiple die. Such a punch and die is useful only for punching holes in nonferrous metals such as aluminum, brass and copper. For punching holes in steel the die should be made from tool steel and hardened.

See also: carving; drilling; drill-press table; drum sander; knurling; woodworking.



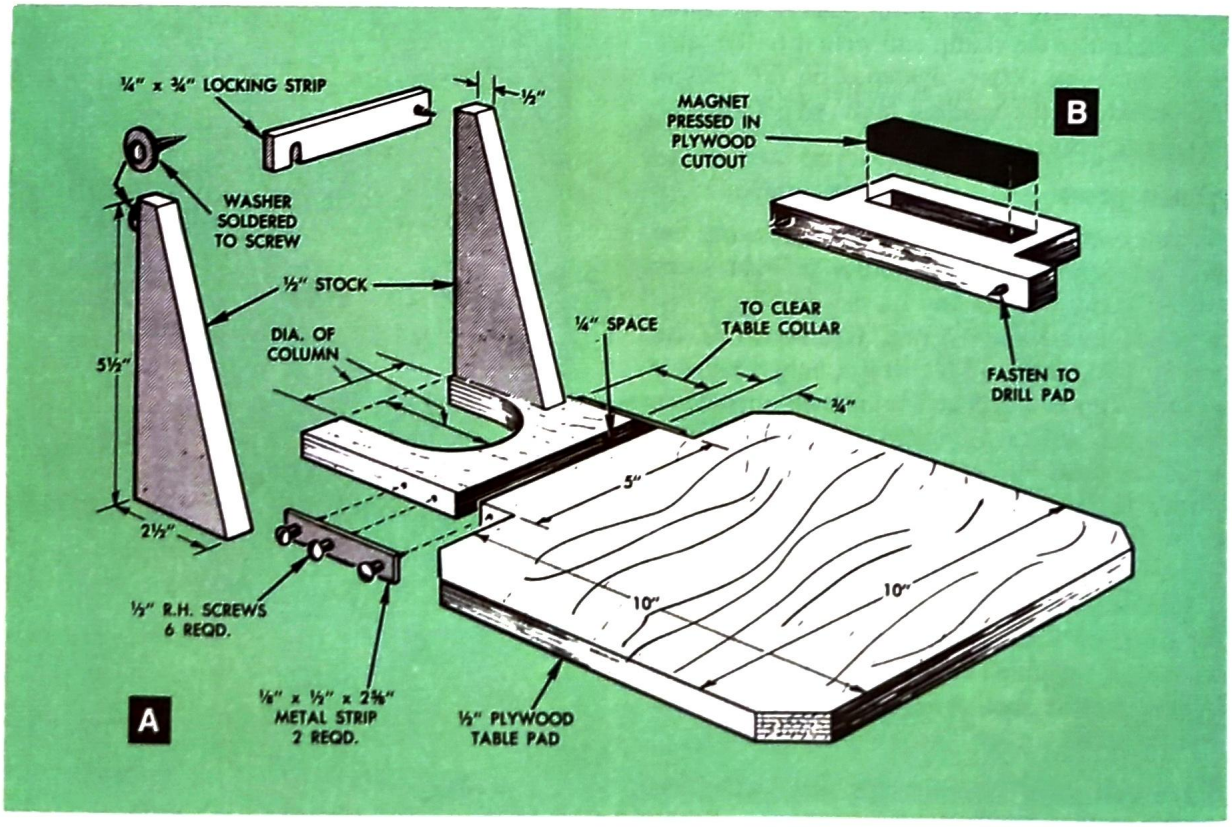


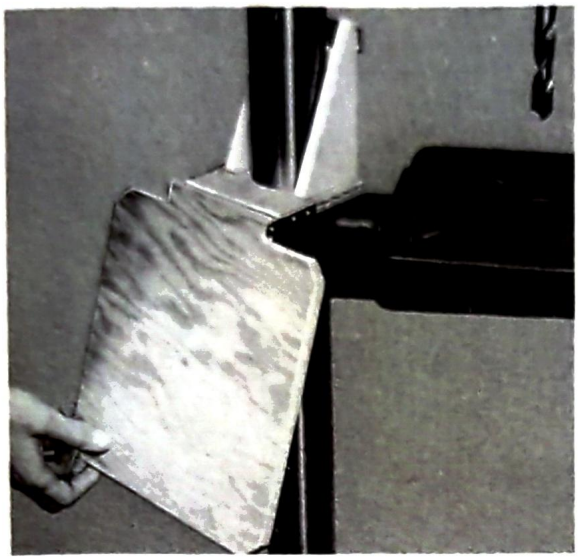
The swing-away pad is shown here in the use position. It is attached to the drill-press column

Swing-away pads for your drill press

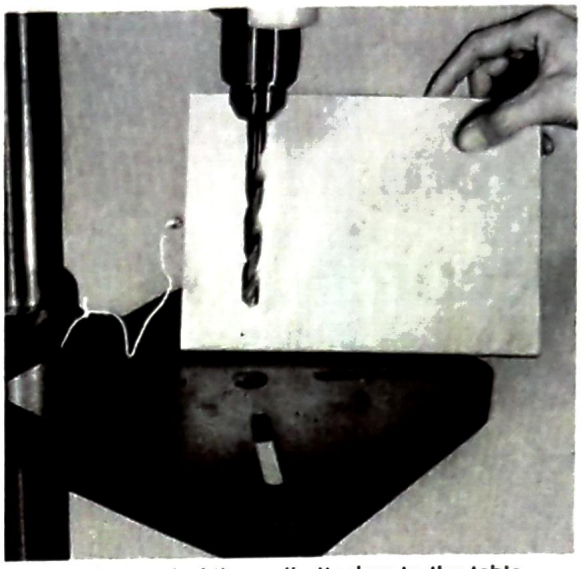
BY RICHARD HANSCOM

Most shop attachments and accessories either cost a lot of money or take valuable time to make. Here's one that can be done in nothing flat with almost no expenditure at all





When not in use, the pad swings away and folds down. It is made of plywood to assure uniform thickness



The simplest pad of them all attaches to the table arm or column with a cord. It's always within reach

WHEN THE PROJECT you're working on calls for drilling through wood or metal on a drill press, you need a backup pad to prevent splintering the wood or burring the metal. The backup pad also protects the machine table when the bit breaks through the work. Of course, you can always grab a piece of scrap material and place the work on it, and this kind of makeshift will serve nicely when all you need is a hole drilled through something.

But when you must be absolutely certain that the hole goes through perpendicular to the surface of the work, this kind of thing won't do. Pictured and detailed on these two pages are two types of swing-away drill pads that are always at hand when needed. You can rely on them for accuracy.

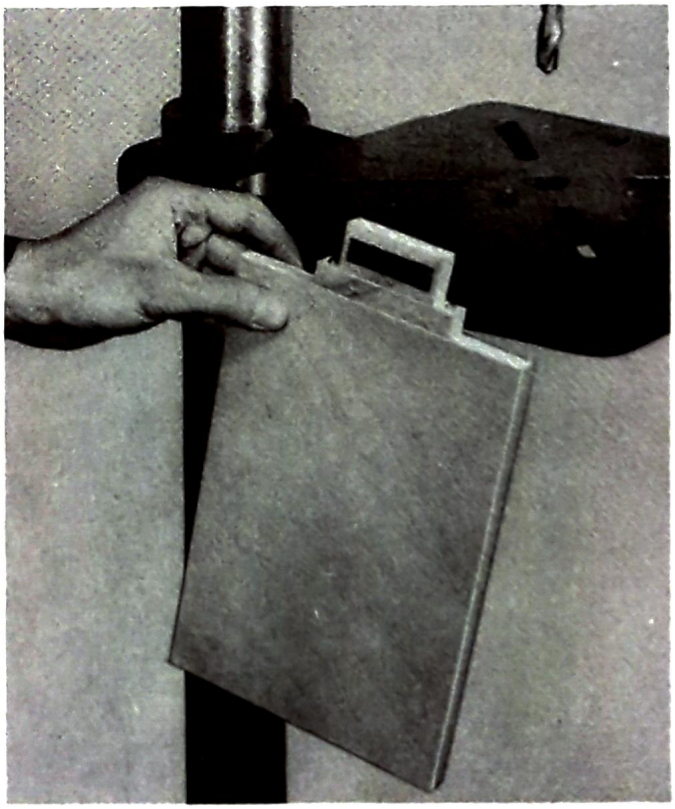
One of these, shown in detail A, attaches to the column and swings away when not in use. Another, which is much simpler to construct, attaches to the column with a length of cord. It's always there when you want it, yet never in the way when you don't need it.

Better in some respects than the others is the third type which has a permanent magnet that is press-fitted into a bracket screwed to the edge of the pad. The magnet holds the pad on the side of the table when you're not using it.

If you do much drilling, you'll have to replace the pad fairly frequently. All of these were designed with this in mind, and changing pads is a simple, quick operation. On the swing-away pad, only two screws need to be removed; the magnet is held in a plywood cutout which is also attached to its pad with only two screws.

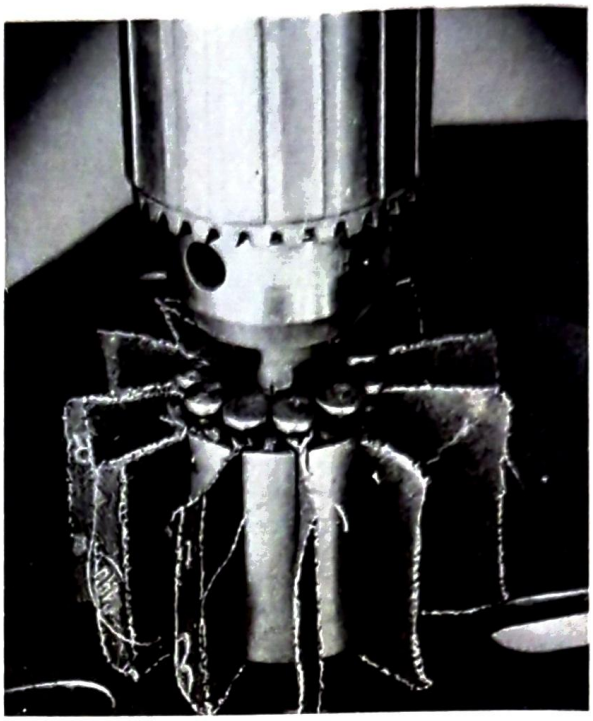
You don't have to get fancy and trim the corners of your pads if you don't want to, but it is neater looking and a little more convenient if you do. You are accustomed to the rounded corners of the drill press table, and the square corners protruding may get in your way.

Perhaps the best of the three designs shown is this one with a permanent magnet that holds it anywhere



Motor armature becomes a contour sander

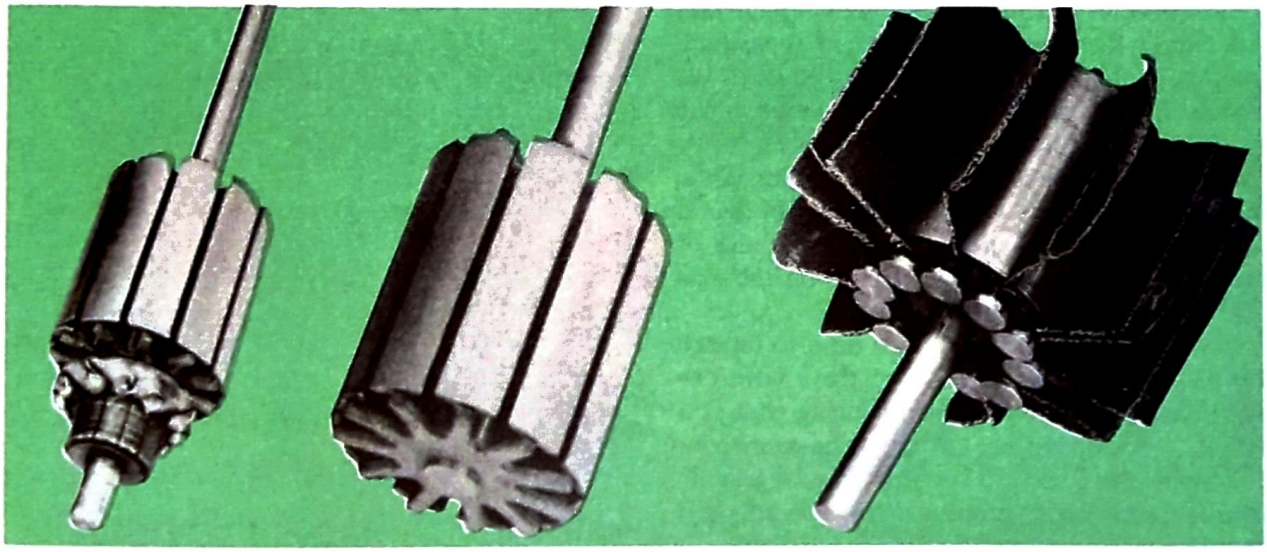
By C. B. DOMBROWSKI

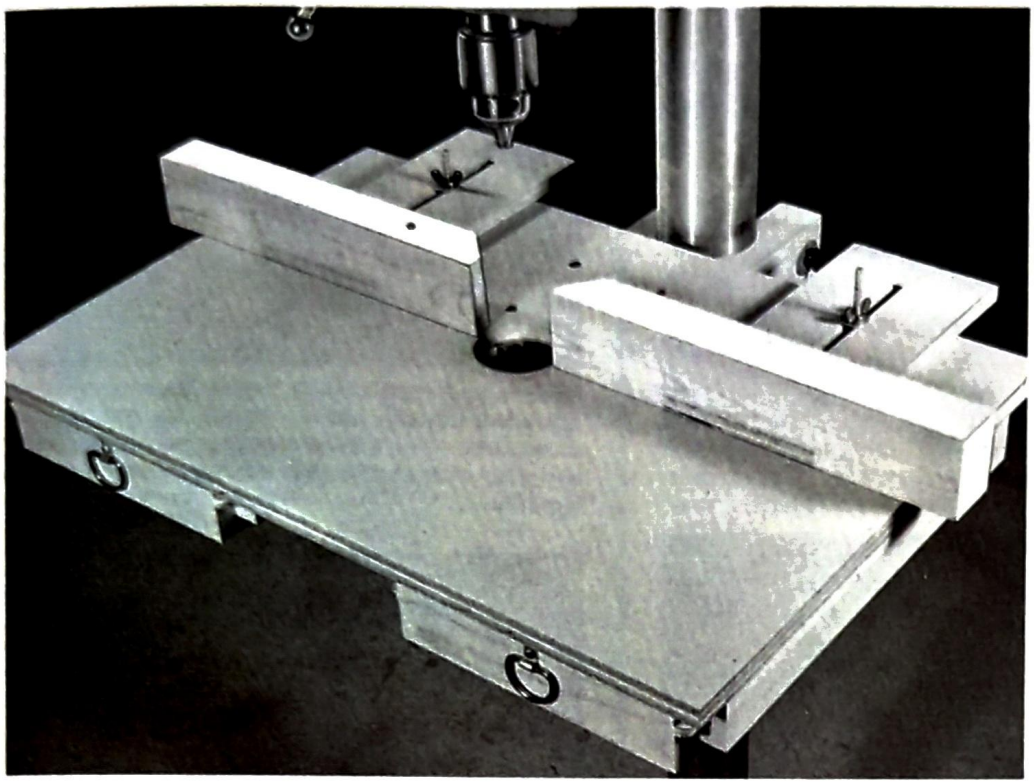


THE ARMATURE IN ANY small junk motor will make a dandy contour sander for your drill press. It's so readymade as an arbor that it requires little more than removing the copper windings and sawing off the commutator (photos below) to adapt it to the drill chuck. The equally spaced slots around the laminated core provide a perfect means for inserting loops of cloth-backed abrasive strips and locking them securely with retaining pins made from common nails.

Choose an armature having a ¼ or ⅜-in. shaft and slots wide enough to accept the doubled abrasive strips. After stripping off the commutator, shorten the pulley end of the shaft. Then insert the looped strips in the slots with the abrasive side out. A contour sander such as this will make quick work of sanding round and concave surfaces, and the replacement of the sanding strips is not at all difficult.

The photo above shows how the sander will fit into your drill press, and the photos below show stages in the development of the sander.





All-purpose drill press table

BY R. J. DeCRISTOFORO

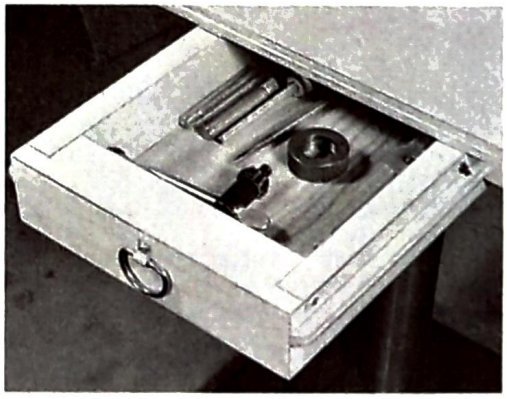
It readies your drill press for woodworking jobs without delays for makeshift setups

HANDLING SUCH WOODWORKING jobs as shaping, pattern routing and drum sanding on a drill press is made much more convenient with this auxiliary clamp-on work table. It lets you perform any of these operations, and many more, without having to stop and rig a separate jig.

Drill-press accessories can be kept at your fingertips in two shallow drawers that run in dadoed tracks below the table, providing handy storage space for small items.

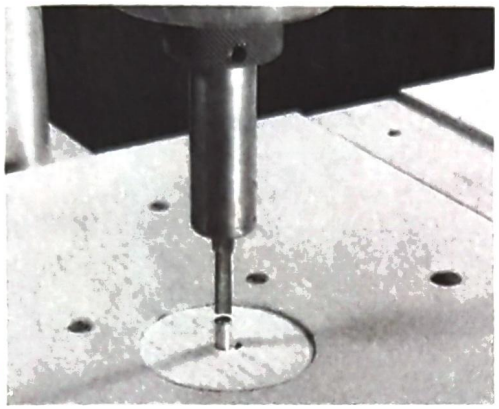
For straight drilling operations in which you may prefer to support the work on the drill-press table itself, the auxiliary table can be removed by simply backing off a wingnut to unclamp it from the column.

Make the table top from some smooth-surface material such as particle board or hardboard-faced plywood. The remaining parts can be almost anything you like, although it would be

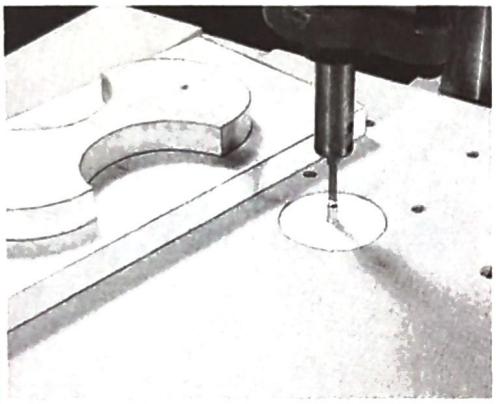


Two shallow drawers provide convenient storage for chucks, keys and other items. The improvised pull was made from a metal chest pull

drills, twist: see lathe accessories; slotting
dripping pipes: see condensation



1



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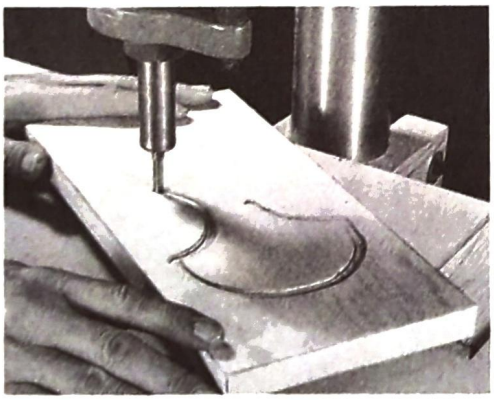
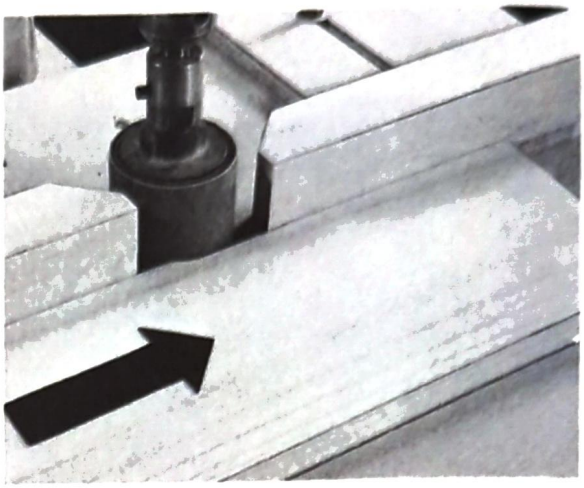


3

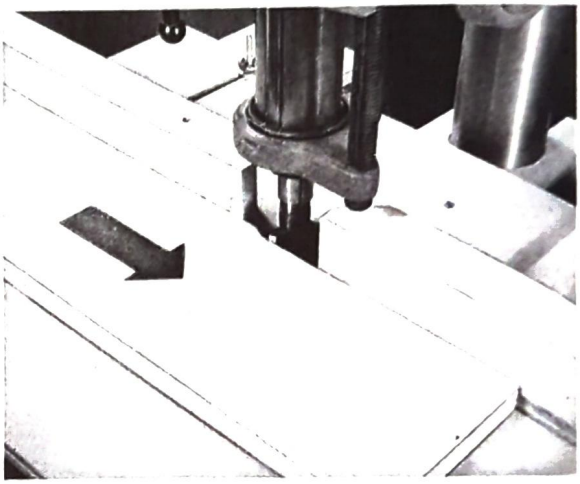
1 Step 1 in pattern routing is to place routing guide in table hole. To make the guide, turn a wooden disc to fit the hole; then, with disc set flush with table top, drill the disc to take a ¼ x 1-in. rod

2 Step 2: Nail the master pattern to under surface of the work. Pattern may be a fully shaped cutout as shown, or a block with a groove of the desired size routed into its bottom surface

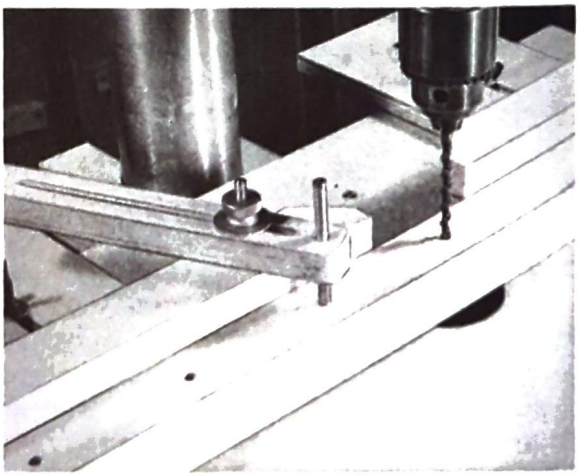
3 Step 3: While making the cut, be sure the pattern's edge butts against the guide pin at all times. Since the router bit is aligned with the pin, the cut will duplicate the pattern's shape exactly



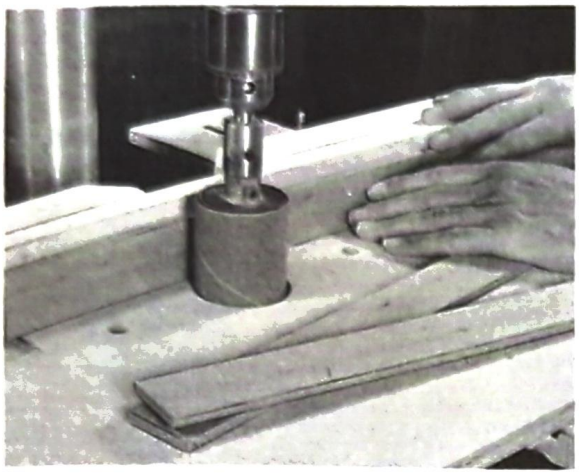
Sanding edges to be butt-joined is one of many operations possible with the all-purpose drill-press table. Place a drum sander in the chuck and offset outfeed fence to make up for the stock removed



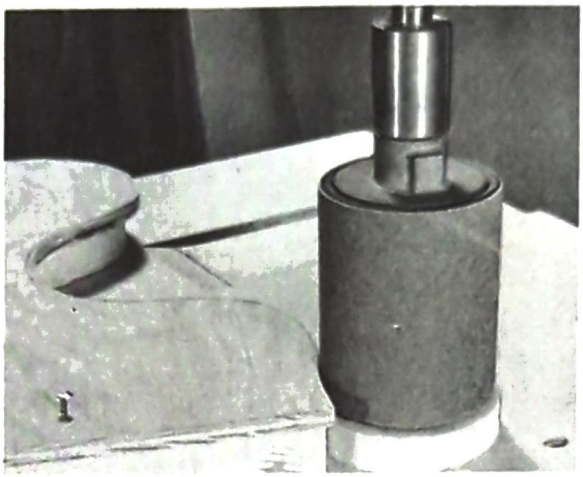
A straight-face cutter is used for light jointing cuts when the entire edge of the stock is to be removed. Here, as in edge sanding (above) the outfeed fence is moved forward in order to support the work beyond the cut



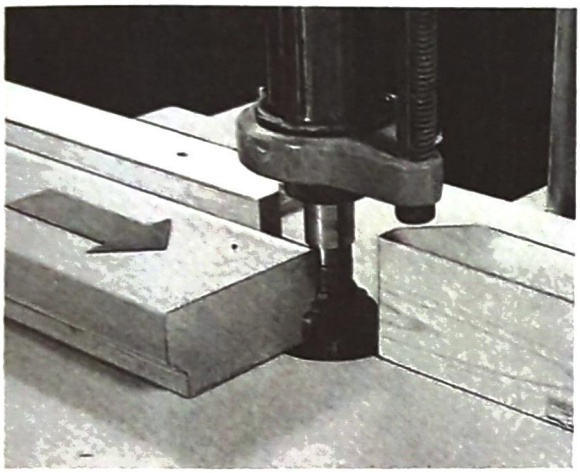
Drill spaced holes by means of an indexing pin. After drilling each hole, move the work until the pin engages that hole, then drill next one. Pin is tapered to engage holes up to ¼ in. in diameter



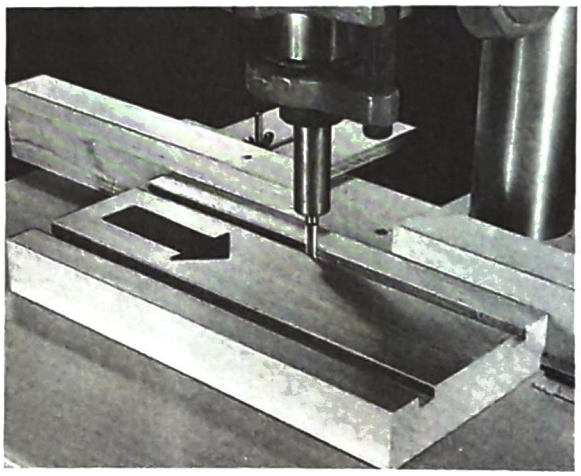
Dressing slats to a uniform thickness is also accomplished with a drum sander. See that the fences are aligned far enough behind the drum sander to permit insertion of a wood strip to span the opening between fences



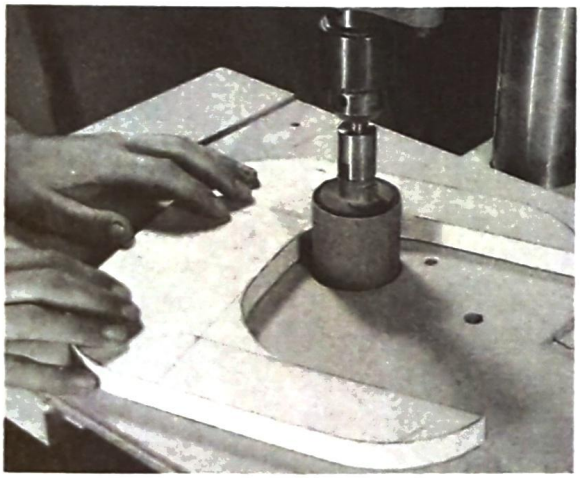
Pattern sanding is simply a matter of nailing a slightly undersized pattern of the work to the underside of the workpiece, which has been rough-cut. The pattern rides a guide disc that has been placed in the hole in the table



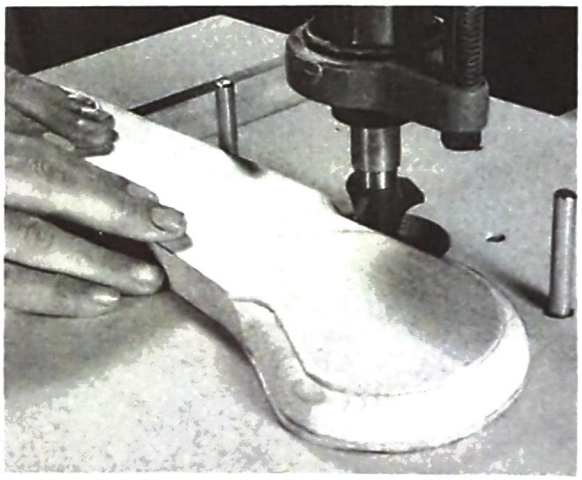
For shaping cuts in which part of the edge is left intact, make sure that both fences are aligned. Always feed work against direction of rotation of the blade so its action will tend to press the work against the fence



Straight-line routing also requires the use of both fences, perfectly aligned. Since the drill press spins much more slowly than standard routers, you must feed the work very slowly, and make deep cuts in the ⅛-in. increments



For contour sanding of inside and outside edges, remove both fences and guide the work freehand. To get maximum use out of the abrasive, raise or lower the quill as parts of the sleeve become worn



Shaping curved or circular edges is facilitated by inserting fulcrum pins in Tee-Nuts installed for that purpose (see drawing, next page). Work piece must be supported by at least one pin at all times

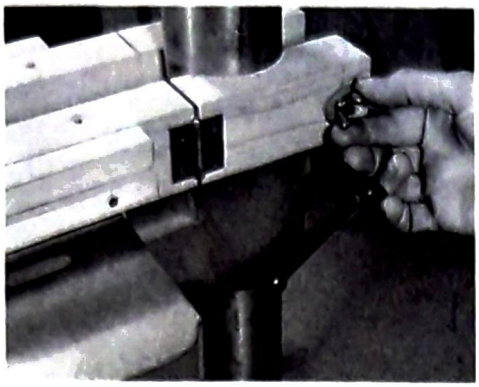


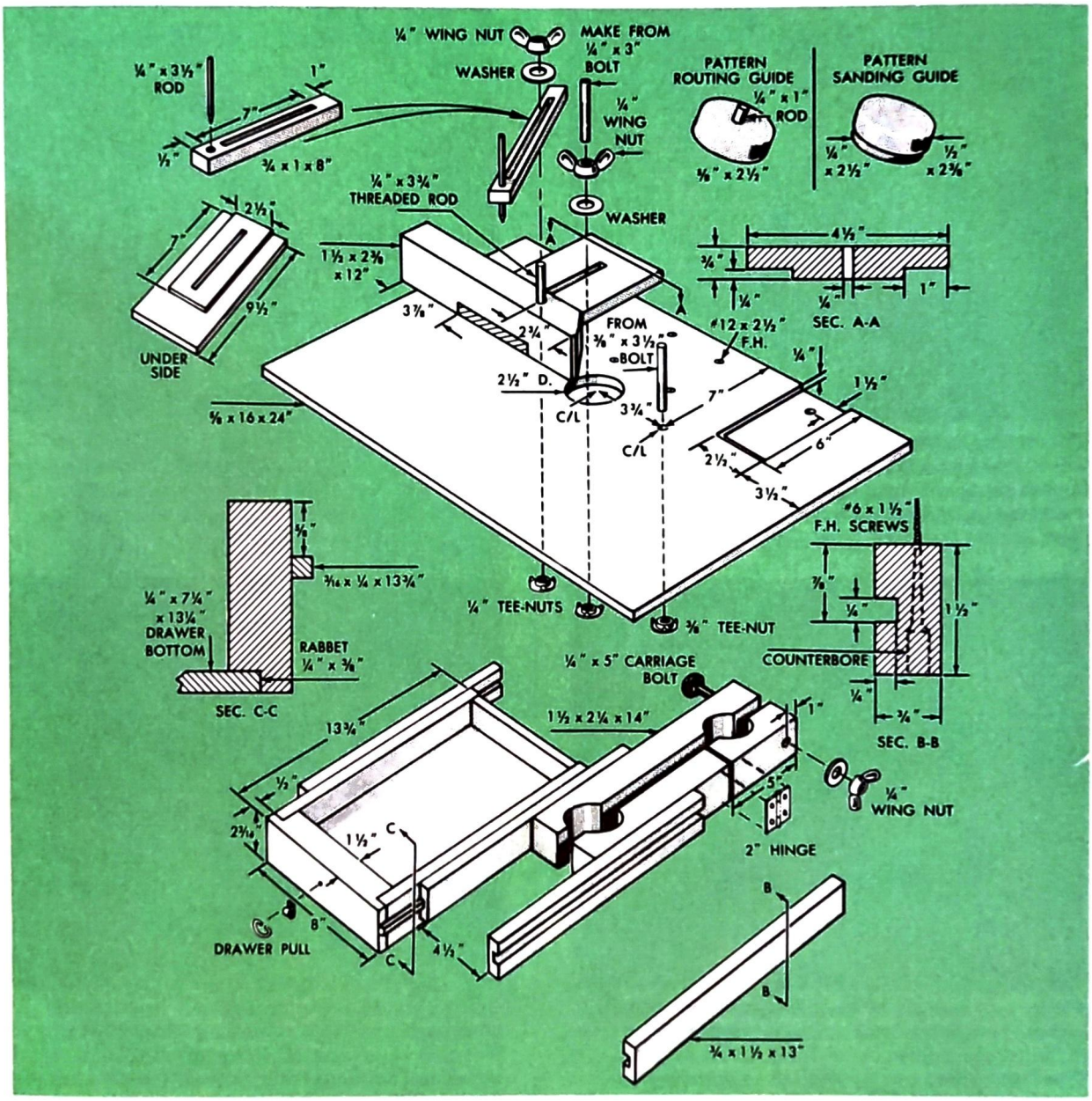
Table support is hinged for quick removal. Note that support rests directly on the drill-press table

advisable to select a hardwood for the fences.

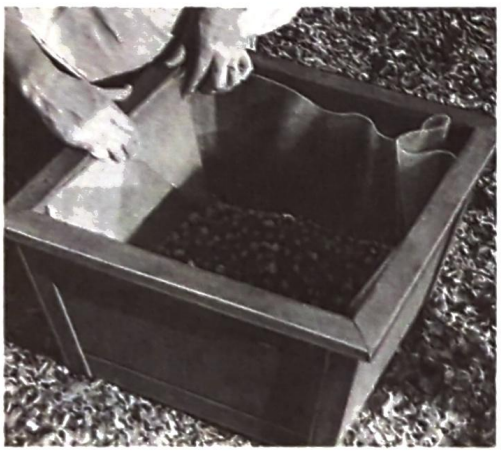
You will have to take certain dimensions, such as the diameter of the drill-press column and the distance from the table hole to the column, from the machine itself.

In attaching the table to the clamp-on supports, make sure that the hole in the work table is positioned so it centers with the drill chuck. Also, see that there is no play in the fence guides, and use the slots in the guides to position the registering holes for the Tee Nuts that hold the fence locks. Give the work table a slick finish by applying a sealer and then waxing.

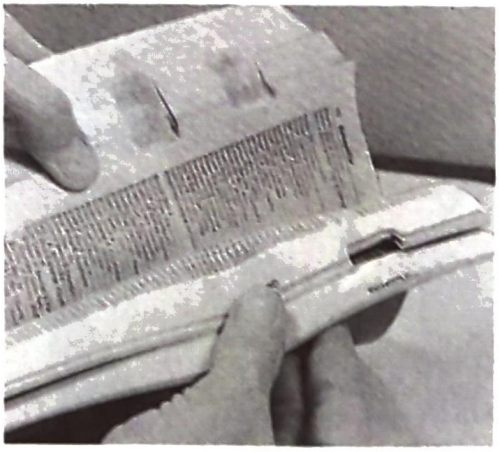
See also: carving; drilling; drill presses; drum sander; knurling; woodworking.



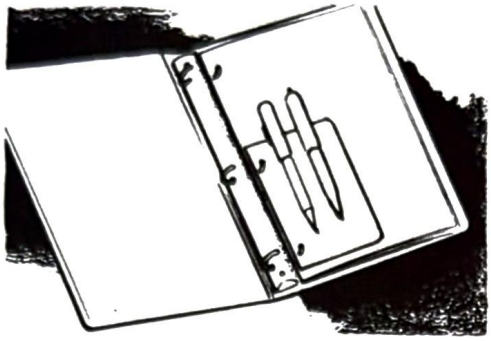
This trundle toy box works like a trundle bed. It provides readily accessible storage for toys and games without loss of floor space. Kids use it as a catch-all junk drawer for storing their "treasures" out of sight. It has 1 x 6 sides and a ⅜-in. plywood bottom. Use 4¾ x ⅝-in. wheels on ½-in. bolt axles.



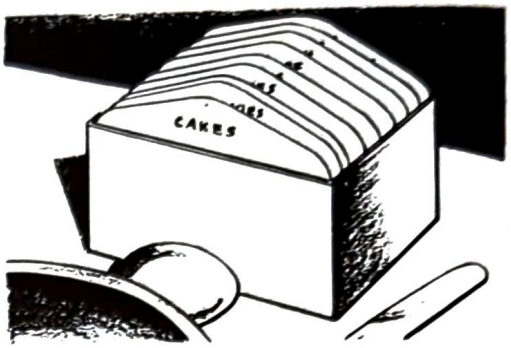
Lining a wooden planter with polyethylene helps prevent moisture from rotting, warping and staining the wood.



Thumb index your phone book by clamping the pages ahead of the desired location and feeding them into a grinding wheel. Grind about ⅜ in. deep, and add tape at the base of the slot.

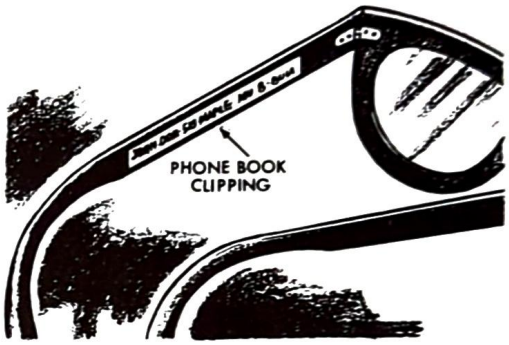


A clip board for your loose-leaf binder, which holds a pen or pencil ready for use, is made from a small sheet of cardboard punched to fit the binder rings.

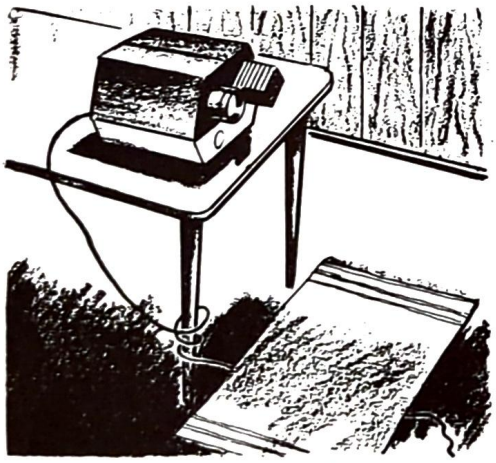


Your envelope file will be much easier to consult if you fold the flaps upright and use them as label tabs.

Cleaning paint brushes will take less time if you cover the metal ferrule with masking tape before you begin the job. Just pull off the tape and throw it away.



An identification label for glasses, pens or other small items can be clipped from the phone book.



Wind the cord from your projector around a table leg and place a small rug over it. This prevents tripping over the cord and damaging the projector.

Reflect light into your basement windows with aluminum foil fastened to the side of the window well with contact cement.

How to go in snow

BY E. D. FALES, JR.

If you get caught in that white stuff that falls almost everywhere, there's no need to sit forlorn and helpless—follow these tested tips

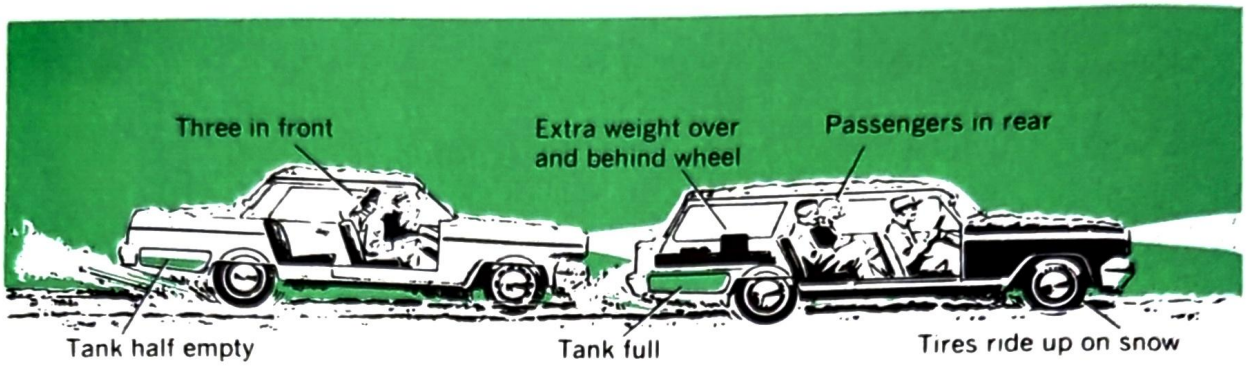
AT BREAKFAST things looked hopeless. Heavy snow had fallen, and I was waiting for the snowplow. I *had* to catch the morning train.

I waded out to have a look. A foot and a half of fresh snow had drifted against the garage door. The driveway and lane were blocked. Sure, I could charge out fast. But there's a sharp left turn in the driveway and my small station wagon would never make it. In fact, it probably would bog down in the first 20 ft.

To make matters worse, the big town plow had sealed off our little road with a wall of snow 4 ft. high. Even if I could get down the lane, I'd never get through that wall of white.

Then I remembered an old north-country snow-driver's trick. In the Lake Erie blizzard country around Hamburg, N.Y., a highway engineer once showed me how to get through

drop-leaf table: see tables
drum float: see floats and docks
dry blueprinter: see copy machine
dry cells: see batteries, dry cell
dryer, clothes: see clothes dryer; clothes dryers, electric; laundry
dryer, film: see film dryer



Weight distribution is an important factor if you want to go in snow. There is a tendency for the front end of any car to sink down with engine weight, and plow the snow. This should be counteracted by rear loading. Weight behind the rear axle will lift the front end a little

snow driving, continued

storms. He opened his car trunk and pointed out several hunks of steel rail—real railroad rail.

"Four hundred pounds," he said. "Suicide if I ever hit anything, but it sure works if I don't."

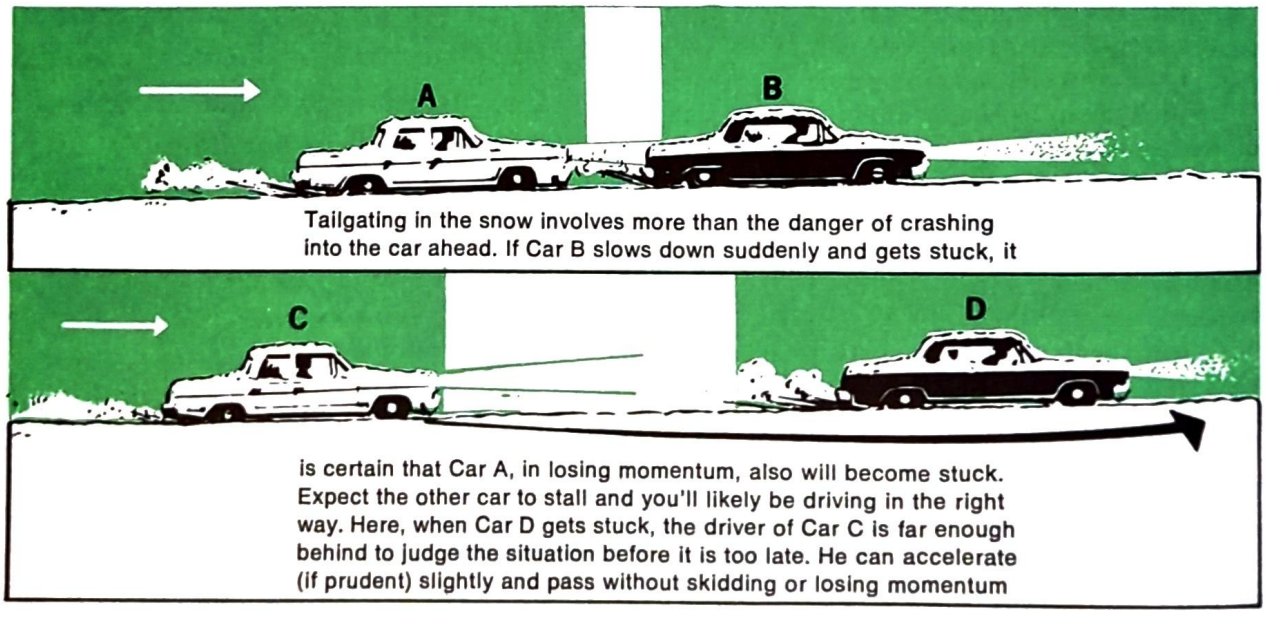
My little wagon had lots of power—and snow tires (a must). But it's light. So I needed something like steel rails.

I looked in the toolshed. I *did* have two old ¼-hp. electric motors, a heavy sledge, two axes and some chopping wedges. I loaded these right over the rear axle. Then I saw a box of tire chains in the garage. Chains might help, but not without weight—and there was no time to pull on chains, anyway. So I dumped the box of chains into the wagon, adding another 10 lbs. or so. Then I piled in a heavy boat-mooring chain, a box of tools, two cinder blocks, a pile of old magazines and a sack of lawn fertilizer. I put some of it *behind* the axle to lift the front wheels and get the transmission out of the snow.

The car now actually tipped backward. Silly? Sure, unless it worked.

Luckily, I'd backed the wagon into the garage the previous night. I started up and let the engine warm a bit before taking off. I needed *momentum;* any good snow-country driver knows momentum is the secret of going in snow.

The tires scorched as my little wagon blasted out, tossing snow forward and to the sides (I guess twin-grip traction would have made it easy,



Tailgating in the snow involves more than the danger of crashing into the car ahead. If Car B slows down suddenly and gets stuck, it is certain that Car A, in losing momentum, also will become stuck. Expect the other car to stall and you'll likely be driving in the right way. Here, when Car D gets stuck, the driver of Car C is far enough behind to judge the situation before it is too late. He can accelerate (if prudent) slightly and pass without skidding or losing momentum

but I lacked it). I had speed enough to make that first hard-left bend by turning the wheels and letting the snow "grip" them while the heavy rear end flung itself around.

Now came the big test—500 ft. of straight lane. She went ahead at a crawl, nose up.

Finally, I saw a big wall of snow coming at me—the pile cast up by the town plow. I poured on the coal to hit it hard. I started up the snow wall *and cut the gas* (spinning wheels would only dig in). The car went up and over like a surfboat. In a wink I was down onto the plowed highway and scooting for the train. Made it, too.

Before I give you more snow-driving tricks, let me caution you—don't get so tricky that you take leave of good sense. Resort to tricks only when it's safe to do so. If you load the rear of your car, unload it as soon as the emergency is over, or you may find yourself in big skid trouble.

- *Never wait for a storm to hit.* When one is forecast, don't run your car into the garage the usual way or you'll never get out. Back in. Then you'll have a dry acceleration lane.

If a really big storm is forecast, it may be wise not to go into your garage at all. Back into your driveway a few feet and leave your car close to the street. But not too close, or plows will bury it. You will need at least a 10-ft. run in order to blast through the plow-pile (after loosening it with a shovel).

ride the down slope

If your driveway slopes down from the street, park your car on the up-slope of your lawn. Then, come morning, you have the help of a down-hill grade, before you hit that snow wall.

- *Keep an open track.* When storms start in the valley where I live, I often run my car in and out of the driveway every couple of hours, rolling out a track. Sure, I hate to get up two or three times during a bad night storm, but I find compensating enjoyment in outwitting a rough one. Also, I have an open driveway when neighbors are out shoveling.
- *Build a temporary winter carport* where it does the most good. I know a man who has put one—just a roof on four nice, ornamental iron posts—right at the entrance to his driveway. Comes a storm, he backs in a dozen feet off the street and his sheltered car is ready to go next morning.

Incidentally, let me suggest that snow-driving tricks are for drivers in all states to know. That's because we all do so much winter traveling these days. Even Floridians get stuck on Christmas trips; so do Californians heading for ski lodges.

- *Keep going! The No. 1 mistake drivers make in snow is that they stop when it's wrong to stop!* At the bottom of hills, for instance, some drivers get timid, stop to look the hill over—and never get started.
- *Leave planning room!* The next big mistake is that most drivers tend to watch the fellow ahead and drive too close behind him. A good snow driver looks *ahead of the fellow ahead.* He expects him to stall out, and when the stall-out occurs he has time and room to go around him.
- *Never spin your wheels.* Once wheels spin, you've usually had it. The good snow-driver never lets his wheels spin for two good reasons: tires heat and form a melt which soon freezes into a slick, and they immediately dig ruts.
- *Keep in mind there's definitely a wrong way to enter a driveway.* Don't try to gun the engine as usual to get up the slight slope from the street. With spinning wheels, a car sometimes actually slides backward down the driveway into the street gutter—and stalls. The right way is to ease off the power and let momentum carry you in.

hills are tough

- *There's also a wrong way to take a hill.* Let's say there's a 6-in. snow. Lots of drivers come down one hill carefully at, say, 25, approach the next hill at 25, and then (as in the driveway) try to make it by gunning the engine. They always lose. They spin crosswise, block the road and tie up traffic. If conditions are really bad, *stop on the previous hill* and wait on the downslope shoulder (if safe) until you're sure everybody ahead of you is going to get up the hill. Unless you can see a way, there's no point in trying.

Continue on down, at a safe 25 if necessary, but on approaching the bottom (or on the flat between the hills), let your speed go up; make momentum work for you. Now, give yourself a *planned speed reduction.* If, for example, it was safe to accelerate to 40 at the bottom, plan to go over the top at 25. Now you have a 15-mile speed cushion. You can lose speed a little at a time, going up, whenever you sense that your rear wheels are working too hard.

- *How about a hill that isn't passable?* A good snow driver "reads" every hill in advance. If one looks doubtful, he waits. If no plow comes, he waits for a big truck. Some chain-equipped semis (and even some without chains) are wonderful snow-busters. You can follow their tracks.
- *Use a starting "pad."* If you don't have a dry garage floor—if you're parked in the open—you can use a trick I've seen used in Maine. With all

snow driving, continued

possible weight in the rear and under power, gingerly roll your car back *just* 2 in. You need only budge it.

Now, roll forward, but not over 6 in. And next, immediately, before the tires can sink in, roll back again. This time go a bit farther. Then immediately go forward once more. Do not "rock." Little by little you roll out a hard-packed pad upon which you get starting momentum.

• *A light, long-handled shovel*—not a wide-bladed snow shovel but a narrow scoop-shovel of light-weight metal is best. Carry it in the car.

Remove snow from in front and back of each wheel. But don't dig under the tread. This only drops the tire and gives it a little hill to climb.

Clear the axles and rear end and then loosen snow beneath the engine pan and transmission.

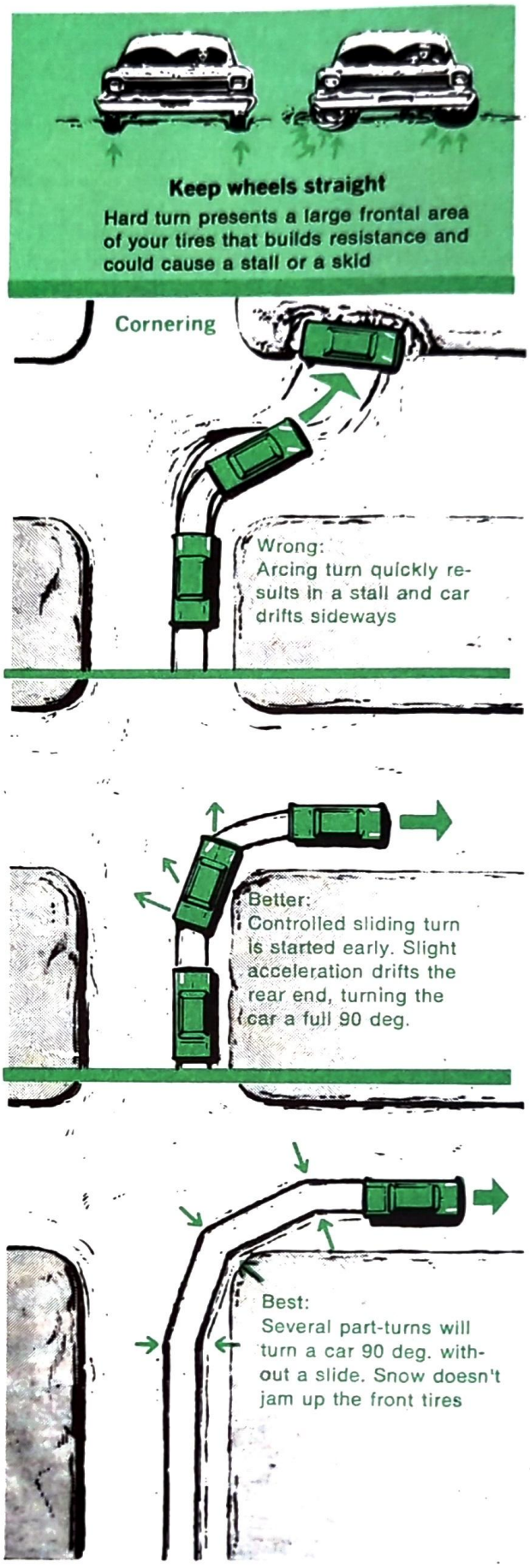
• *Leave wheels on small mounds.* Often I purposely leave each tire standing on top of its own small monument of compressed snow. When I'm ready to drive, the car rolls off the mound. With quick work I can capture the first car movement and keep going.

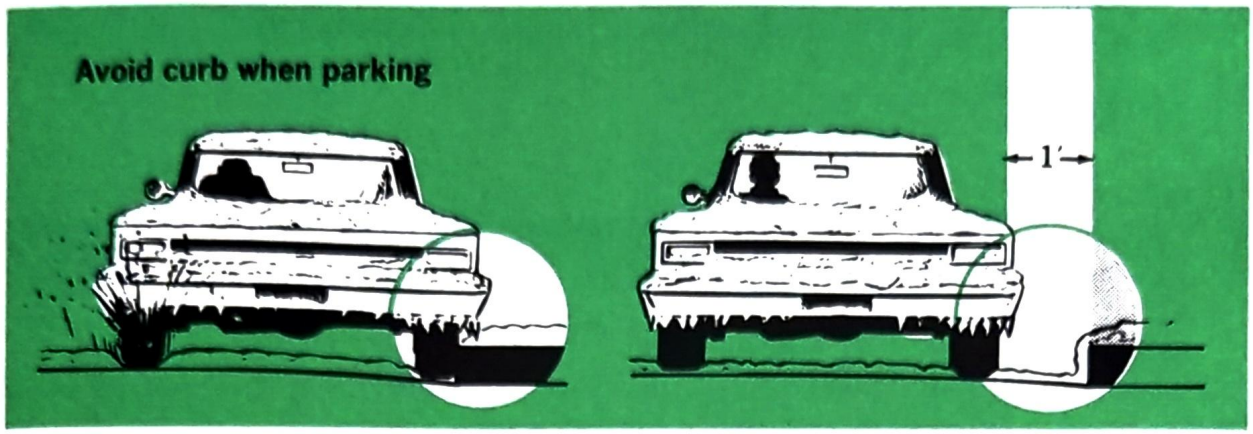
if you're going, go!

• *How to keep going, once you've started.* Next to lightweight rear ends, which cause loss of traction, the biggest cause of stalling in snow is *needless stopping*. Avoid red traffic lights. Time your speed to hit the lights safely on what experts call a "new green." Your eyes must work rapidly, reading the traffic far ahead, plotting a safe way to keep going.

The next big cause of stalls is—*turning*. Remember that your front wheels obligingly cut a track for your rear wheels. No one, however, cuts a track for them. They are pushing constantly against a snow wall. As long as you can keep them straight, they knife into the wall easily. But when you turn them they present a wider area—the sidewalls—to snow. And snow shoves back—hard. This throws a blocking force against the front that overloads the rear driving wheels, and causes loss of traction.

• *How to take turns without stalling.* A good snow driver steers *with his rear wheels*. Let's say it's a 90 deg. right corner. Quiet road. No traffic. Snow up to the axles. Speed, say, 20. He won't make the usual dry-road turn, which would stall him. That is, he won't "square" his turn. He will cut into the turn sooner with a very slight turn of the wheels. Then he straightens his wheels. As the car angles closer to the corner he feathers the gas, feeding just a trace to throw the rear end


Keep wheels straight
Hard turn presents a large frontal area of your tires that builds resistance and could cause a stall or a skid
Cornering
Wrong:
Arcing turn quickly results in a stall and car drifts sideways
Better:
Controlled sliding turn is started early. Slight acceleration drifts the rear end, turning the car a full 90 deg.
Best:
Several part-turns will turn a car 90 deg. without a slide. Snow doesn't jam up the front tires



When rear wheels are jammed against the curb, a car is almost hopelessly stuck. The curbstone holds the wheel although the outside wheel turns. Your only solution is several shovelfuls of sand or salt in front of the curbside wheel—or a push!

When parking along a curb in snow or before the possibility of snow, always leave a good foot of space between the tire and the curb. Starting efforts always drift a car toward the curb. With distance between the tire and curb, you move before they hit

into a very slight left drift. He may now cut his front wheels right and deliberately let the weight of snow block the front of the car for an instant. This helps swing the rear end out.

When the car has turned itself perhaps 45 deg., the experienced snow driver brings the front wheels nearly straight again while the rear-wheel drift continues until the car has swung the full 90 deg. He has completed the turn with no bogging down, skidding or loss of traction.

• *How to get out of a parallel parking place.* How many times have you heard the angry buzz of tires when a parked car is stuck against a curb? Let's stipulate that if a plow has walled your car in, you've got to dig out. But often cars get stuck that aren't walled in at all. There are several ways to get out.

First, when snow is due, try to avoid parking between two cars. Find a spot near a crosswalk.

Second, don't park against the curb. Keep your wheels at least one foot away because it's almost impossible to unpark a car whose right tires have touched the curb—sidewall friction holds the car.

Third, if you must jockey back and forth between two other cars, get out and study your tires, the snow and any ruts. Know exactly what the problem is.

Fourth, feed gas very gently. Quit trying if you hear your wheels spinning.

And again, *don't turn your front wheels!* This is what usually causes all the trouble in that turned wheels also create resistance for cars that are parked. Jockey patiently back and forth, giving the wheels only an occasional, slight twist.

• *What about angle parking?* The trick is not to run the nose of your car close to the curb. Park with your front wheels about 4 ft. back. Now, if you have trouble, you can let your car roll forward quickly, letting the front wheels bounce sharply back from the curb. As they do, go into reverse and back out.

• *How to rock a car with manual transmission.* Don't keep shifting from forward to reverse. Shift to reverse, creep back an inch or two (until you feel a mound of snow formed behind the wheels), then kick out the clutch and let the car roll forward an inch or two. Let the *clutch* take it back in reverse again. When you've built a good forward-backward rocking rhythm, quickly shift to low gear and go.

• *With automatic transmission,* my advice is: Don't try to rock. Use the "starting pad" technique already described.

• *Stay out of slush.* At any speed over 35 mph, front wheels don't respond in the mush called slush. They start to hydroplane and begin sliding straight ahead no matter how you turn them.

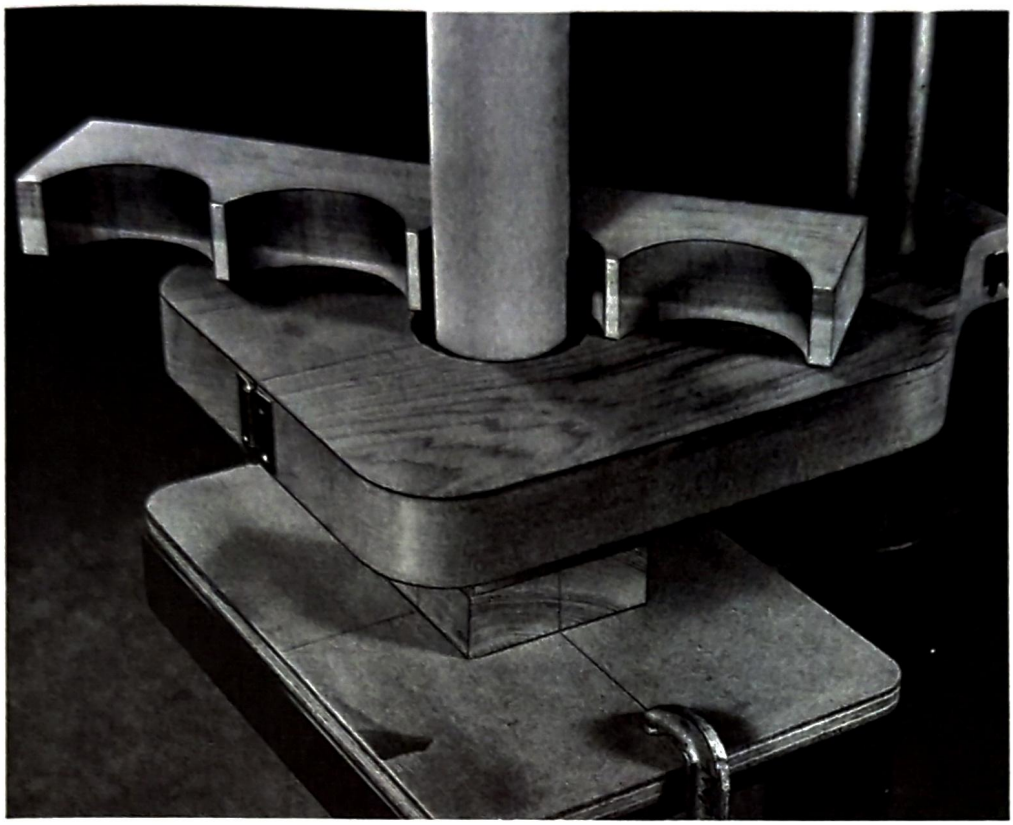
• *Stay off the superhighways when there is slush.* Not only is there a good chance that you will lose control of your car but you can end up driving blind. Buses and trucks passing you can toss tons of slush on your windshield.

See also: antifreeze, auto; batteries, auto; battery chargers; rust prevention; starting, auto, cold weather.

Double-duty sander for your drill press

BY R. J. DECRISTOFORO

Your drill press can handle sanding, polishing and drilling when you add this clamp-on table and ball-bearing lathe center



Square edges are shaped accurately on this sander table, which is easily locked to the column of the drill press with a wingnut. The table can be moved up and down to permit the full use of the sandpaper. It also can be used with a conventional sanding drum

THIS LONG-DRUM SANDER does just about everything that can be done on a commercial oscillating-spindle sander. And in addition to the common jobs requiring use of a sanding drum, the novel construction of the unit adapts it to concentric drilling of deep holes, also polishing, filing and even file-shaping of any round stock that can be held in the drill chuck.

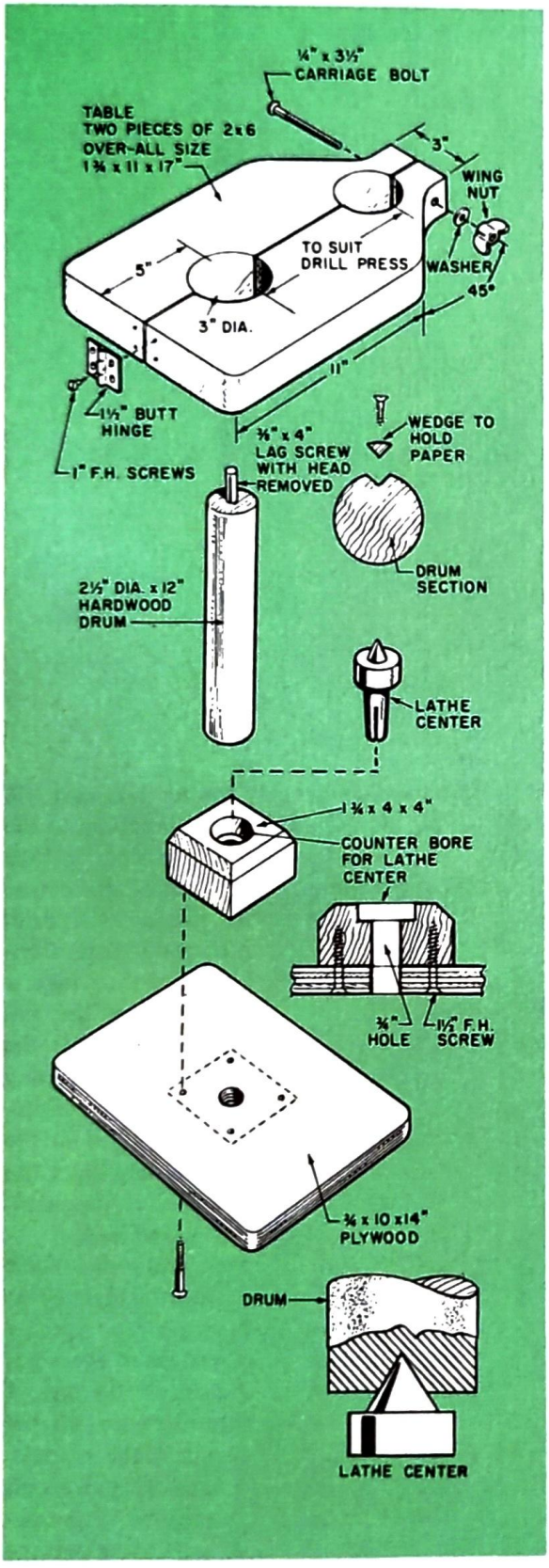
It's designed to fit a 15-in. floor-model drill press but by shortening the drum somewhat you can adapt it to use on a bench-type press. In use the upper end of the drum is held in the drill chuck and the lower end is supported on a conventional ball-bearing 60-deg. lathe center which rotates with the drum.

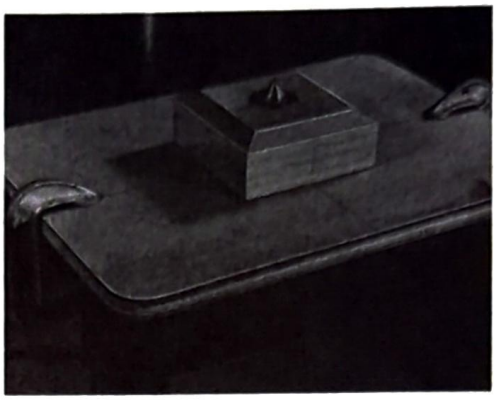
Cut the base from ¾-in. plywood to a size that can be clamped to the drill-press table, center-drill it, then cut and counterbore a square of hardwood to serve as a mounting for the lathe center. Be sure that the counterbore takes the lathe center in a light, press fit yet allows it to rotate freely. Screw this mounting to the base with the holes in alignment.

The drum is turned from hardwood to the dimensions indicated and Vee-slotted on a table saw. Save the waste piece from the slot as it will be used to clamp the sandpaper wrapping to the drum. Center-drill one end of the drum to take the point of the lathe center, using a lathe center drill if available. Otherwise use a twist drill, running the hole to a depth of about ⅜ in. Center-drill the other end of the drum to take a ⅜-in. lagscrew. Turn the lagscrew in the full length of the threads, cut off the head, file the cut end square and then polish the projecting body of the screw with a strip of abrasive cloth. This serves as the spindle to be gripped in the drill chuck. Make a trial setup, turning the drum by hand. If the drum tends to bind at any point, bend the spindle slightly until it spins freely.

The sanding table is made from two short lengths of selected 2 x 6-in. stock bandsawed to the contours indicated. Clamp the pieces together edge to edge and scribe the location of the holes for the drum and drill-press column. Be sure of the size and center-to-center distance of the holes. Then separate and bandsaw the cutouts. Reassemble with a hinge at one end and a bolt and wingnut at the other as indicated in the details. This construction of the work table permits

drill-press sander, continued



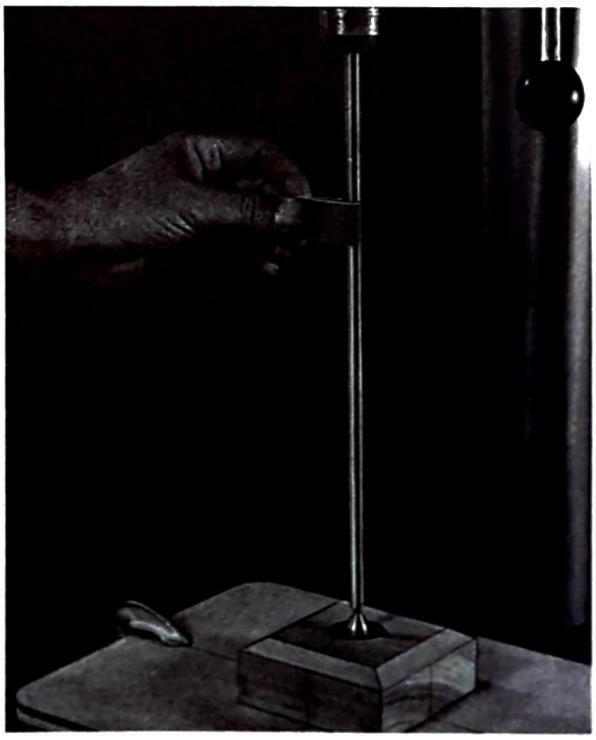


The base of the jig clamps to the drill-press table. Move it until the lathe center aligns with the drill bit, then make permanent alignment marks on the base and the table

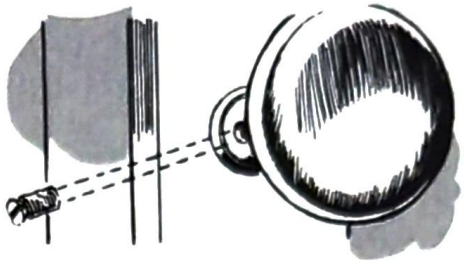
easy, quick removal and replacement and also allows the table to be positioned at any convenient work height. By sliding the table up or down you can utilize all the abrasive on the drum. If desired, the drum can be faced with ⅛-in. felt. Sandpaper must be wrapped tightly about the drum and held with at least four screws through the wedge.

See also: band grinder; band sander; belt-disc sander; belt sander; drill presses; lathe accessories; pad sander; sanding jig; spindle sander.

Carefully position the sander table, then use this setup for polishing, cutting or shaping bar stock. It also makes an excellent rig for concentric drilling

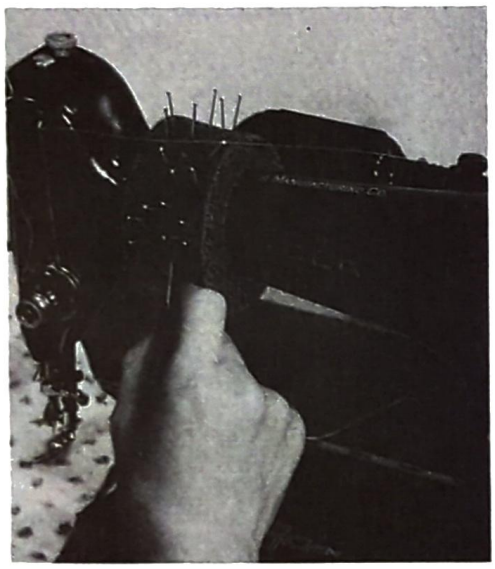


To store a small ladder in the least possible space, stand it up straight against the wall between the studs in your garage and secure it with a long-arm turnbutton mounted on a protruding block.

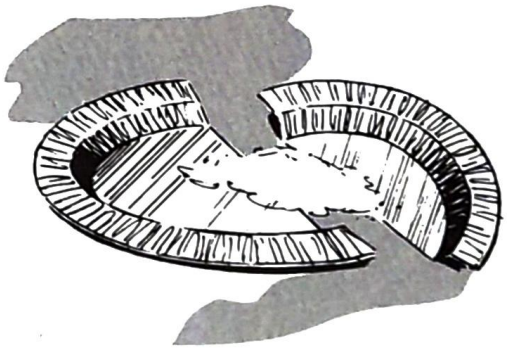


When the setscrew holding a doorknob works loose, wrap the screw with a turn of cellophane tape before replacing it. The tape will tighten the grip between threads.

If you need staples for framing a picture, you can make a few by snipping wire paper clips in half. Then cut them at an angle to form bevel ends.



A pin-cushion collar of foam plastic on your wife's sewing machine is always handy and can't be misplaced.



A disposable dustpan is the perfect tool for cleaning up spilled food or other moist materials. To make one, cut an aluminum-foil pie plate in two, leaving two thirds for a pan and one third for a scraper.

If you're adding a room, partitioning an attic or basement, or if you have to solve the problem of plaster walls that are cracked and ugly, you'll want all of the details on

How to remodel with drywall

BY STEVEN J. HOWARD

WITH A LITTLE SKILL, plus a few tricks of the trade, the amateur remodeler can apply drywall almost as well as a contractor.

To get these tricks for you, we recently interviewed a number of pros, then boiled down their information. So here, right from the horse's mouth, is the inside dope on remodeling with drywall.

Since the most common use of drywall—also called gypsum wallboard and plasterboard—is in finishing a new room, let's approach the subject from that angle. You've built a new room on your house, or are turning an attic into an extra bedroom. The siding and roof are on, the flooring or subfloor is down and the studs are waiting to be covered. Here's how you go about it:

- **Preparatory steps:** The first thing you do is estimate how many sheets of plasterboard you'll need. To do this intelligently, mull over these facts:

1. Plasterboard for direct nailing to studs is

drywasher: see gold panning
dry wells: see basements

available in four common sizes—4 x 8, 4 x 10, 4 x 12 and 4 x 14 ft.—and in two thicknesses—⅜ and ½ in. The thinner and less expensive ⅜-in. plasterboard is perfectly adequate for most rooms. But the sturdier ½-in. thickness is recommended for, say, a family room, where junior might drive a wagon or bike into the wall.

2. To estimate how many sheets or panels of plasterboard you'll need, measure the length, width and height of the room. You might be able to estimate in your head, as the pros do, how many panels you'll need, but if not, make a diagram like the one on page 844. Figure on using the largest-sized panels compatible with the room's dimensions. The smaller sizes may be easier to handle, but the larger ones cover an area more quickly and reduce the number of joints you'll have to cover with cement and tape.

For example, suppose the room measures 16 x 24 with an 8-ft. ceiling. Most amateurs would cover each 24-ft. wall with six 4 x 8 panels, and each 16-ft. wall with four 4 x 8 panels—all applied vertically. However, a pro would save a lot of time by putting four 4 x 12 panels on each 24-ft. wall—installed horizontally. The reason for this is that the six vertical 4 x 8s give you five joints (or a total of 40 ft.) to nail and tape, while the four 4 x 12s give only four (for a total of 32 ft.). On the 16-ft. walls, you'd require four 4 x 8 panels whether you installed them horizontally or vertically, and would get the same amount of taping either way. However, you should apply them horizontally, to be consistent with the 24-ft. wall.

Now, suppose you have a non-standard ceiling height that won't work with the 4 or 8-ft. modules we've discussed so far because it's 2 or 3 in. greater than 8 ft. You would still use 4 or 8-ft. panels but simply hike them up to the ceiling and fill the space at the bottom with scrap plasterboard before nailing on the baseboard.

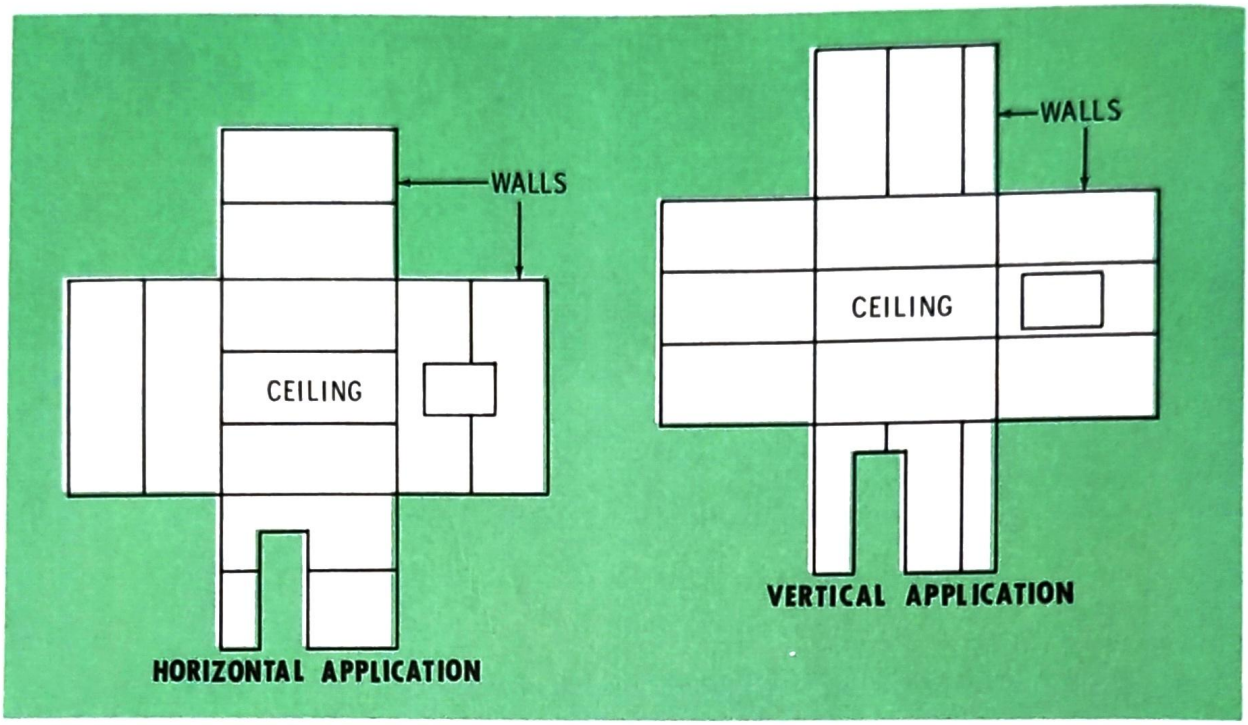
3. In estimating, use overall wall dimensions. Deducting windows and doors in the hope of reducing panel requirements won't save you enough to speak of, and you could even find yourself minus half a panel just as you're ready to finish the job. Live with the fact that there's going to be some waste when installing plasterboard on most walls.

4. If ceiling height is greater than 8 ft.-3 in., vertical installation of panels is more practical than horizontal, since a 4 x 10 panel, for example, can be cut to fit a 9-ft. ceiling height.

The same principles should be considered when determining whether panels on a ceiling

Remodelers can obtain professional results using plasterboard. In the room above, the wall behind the desk was "paneled" with wood-grain plasterboard

Vertical application of plasterboard is the method most amateurs favor. However, in many rooms, horizontal application can save a lot of nailing and taping

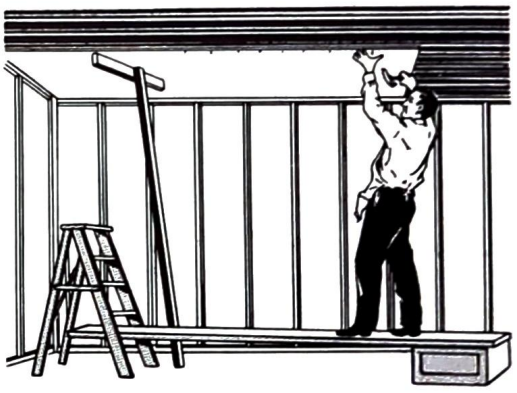


To estimate the number of panels you'll need, make a scale drawing of the room with the various sizes of panels, both horizontally and vertically installed, indicated. Drawing above is of a typical room

should be installed horizontally or vertically in relation to the joists.

- **Start with the ceiling:** This will permit you, when doing the walls, to work from the top down, with less danger of marring the plasterboard if a hammer should slip. It also permits an easier, better-fitting installation of the panels.

Pros don't waste time by making supports to brace a panel against ceiling joists. Instead they literally use their heads. They first set several planks on horses, so as they walk along them, they're able to cover the entire length and width of the panel. The planks are high enough off the floor so workers standing on them can actually brace the panels with their heads while nailing is done.

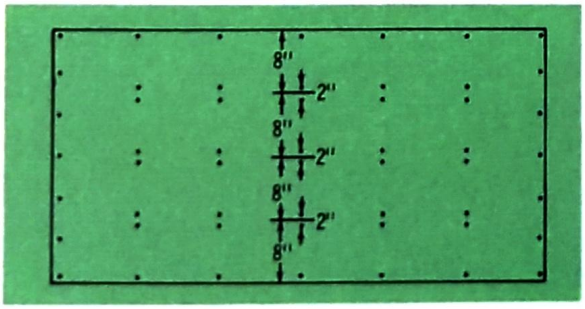


When working alone, make a T-brace of 2 x 4s to steady ceiling panels. You can also use a plank "catwalk" which permits freer movement than a ladder

This method presupposes that two workers are on the job. If you're working alone, then some sort of brace has to be fashioned to help support a ceiling panel for nailing. Such braces are commercially available, but the most common method is to make a T-brace from 2 x 4s. This brace is forced against each panel to secure it while it's nailed into place. The danger here is that a T-brace can slip while you're nailing.

In driving the nails, use a backhand hammer stroke. This permits you to keep an eye on the nailhead and reduces the chance of damaging the panels with misdirected blows. Also, work slowly. Plasterboard is not made of steel, and

After you have nailed the panel in place, go back and drive an extra nail 2 in. from each initial nail, except at the panel edges. Study the pattern below



when you don't hit the nail with every stroke, you'll have a lot of extra patching to do later on.

In nailing up the first panel, edge-nail it initially. All other nails are lined up by eye with the edge nails. But if you prefer a more exact guide, draw a line from each outer edge nail, down the joist center, to the opposite edge. You can now nail along these lines.

Nails in ceiling panels should be spaced about 7 in. apart. After each panel is nailed in place, go back and drive a second nail 2 in. from each nail, except at the panel edges. This double nailing (drawing page 844) resists the loosening forces that work against the nails. These forces are greatest in the center of the panel.

• **Working on walls.** Before putting up wall panels, go around the room and make an identifying mark on the floor below all fixtures that will require cutouts in the plasterboard, such as heat ducts and electrical outlets. There are two ways in which cutouts can be made, both of which we'll discuss later. For the meantime, mark on the floor, below each fixture, its width, plus the measurements from the floor to the bottom and top of the fixture.

To install a horizontal panel at top of a wall, rest the panel on the floor and against the studs in the exact position it'll be nailed. Drive a few nails in line with the stud centers along the top edge of the panel—not all the way through the panel, but just far enough so they take hold. These are brace nails that will hold the panel in place after it's raised into position so you can complete nailing without having to support the panel with one hand.

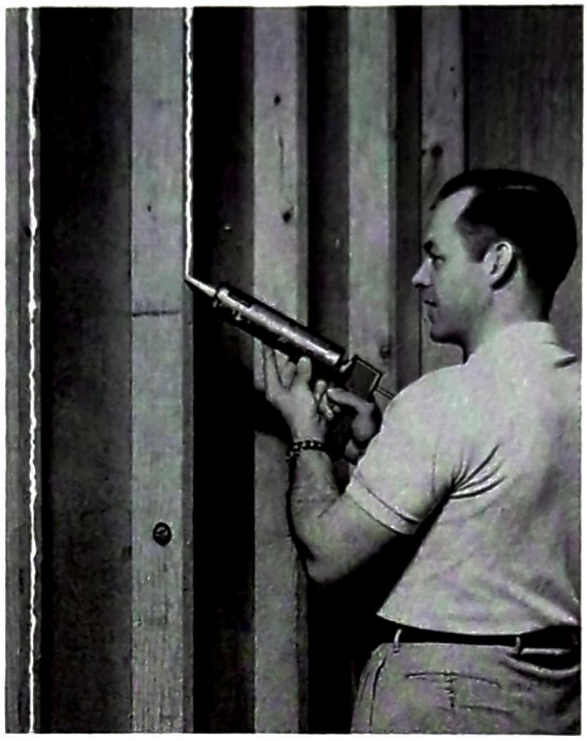
Again, if you're not experienced in placing nails over the stud centers by eye, draw guide lines on the panel before raising it into position.

Now, if there are two of you or if you're strong enough to do it by yourself, raise the panel into place so its top edge butts against the ceiling (but don't jam it), and drive the brace nails into place.

If you're working alone and the panel proves too cumbersome, nail a strip of 1 x 2 across the studs at a height that permits it to support the panel against the ceiling. When you lift the panel, rest its bottom edge on this support, hammer in the bracing nails, and pry off the support strip.

After driving the bracing nails, start your final nailing at the center of the panel, working out toward the edges. This prevents bowing of the panel, which may cause nails to "pop" later on.

When nailing, hold your free hand firmly against the panel to make sure the panel is tight against the studs and the nail goes in the full distance. Carelessness in this step will, again, encourage nail popping in the future.



The adhesive method of applying plasterboard employs beads of adhesive to hold the panels in place. Nails are used only at the edges of panels. This method reduces nail popping but can't be used on ceilings

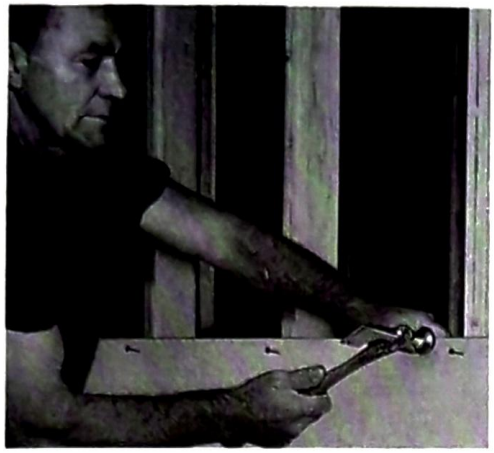
Place nails about 8 in. apart. After the nails are in place, go back and drive a second nail about 2 in. below each nail, except on the edges, as you did on the ceiling.

Never countersink nailheads on either ceiling or walls. Drive them fully home, leaving a slight dimple in the surface of the plasterboard, to be filled later with joint cement. But make sure the dimple isn't deep enough to tear the paper surface of the board, or the material inside the board may crumble around the nail.

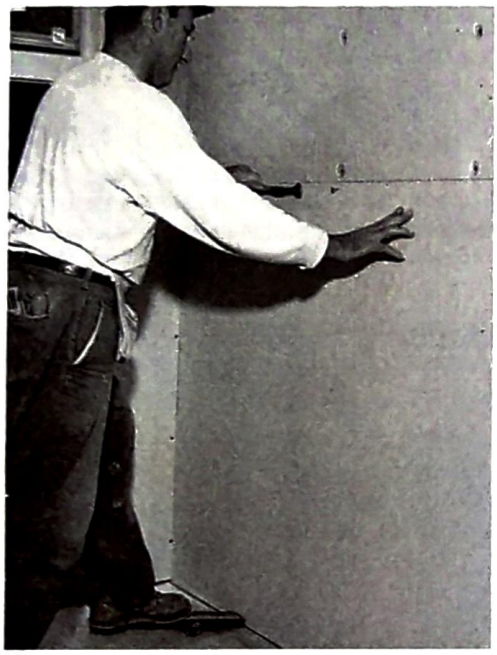
With top wall panels in place, the bottom row is ready to be installed. Again, there are tricks to this. Prop the bottom panel against the wall, putting in a few nails along its top edge and drawing guide lines for nails, if necessary, as you did on the panels already installed.

To facilitate positioning of the bottom row of panels, fashion a lever from a piece of lumber by beveling one end. Place it over a piece of broom stick or pipe, bevel side down. Put the beveled end beneath the panel and press down on the lever with your foot to hold the panel while driving the brace nails.

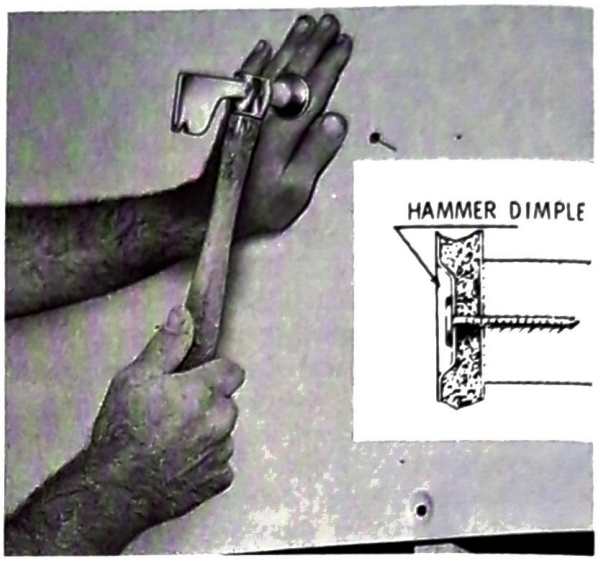
Bottom panels are nailed in the same manner



Before lifting a panel into place, put it under its final location. Partially pre-drive top nails, using stud centers to position them



Positioning of the bottom row of panels can be facilitated by a foot lever made of beveled board levered over a pipe or broomstick



To conceal the nail heads, drive them slightly below the surface of the plasterboard. Create a slight dimple with the hammer but don't break the paper surface

Always use a T-square with a metal edge to guide your knife when cutting straight lines across widths of plasterboard. You do not need to cut through the board. Just score it enough so that it will break

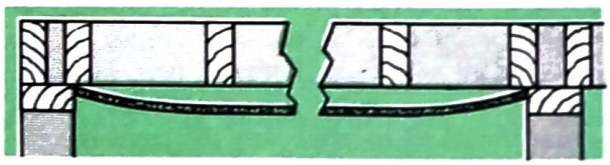
as the top—from the center out to the edges.

• **Some important considerations:** Never make joints between plasterboard panels too tight. Proper technique calls for a 1/16 to 1/8-in. gap, for play, between panels. The cement forced into these gaps later on will strengthen the joints.

Furthermore, if a panel is forced too tightly into place, it could bow away from studs and prevent full nailing (drawing, this page). So, always cut a panel to fit.

Thus far we've been speaking of nailing panels to the studs. There's another and more modern method which more and more contractors are using—plasterboard contact adhesive. The advan-

The drawing below shows the undesirable bowing effect which is the result of forcing a panel into a tight space. Cut the panels to fit easily without force



To make straight lengthwise cuts, press your knife blade against the end of the ruler. Then, applying enough pressure to score the plasterboard, guide the ruler along the top edge of the panel with your finger

tage of this method is that it reduces the number of nails per panel and, consequently, the amount of eventual nail popping. It also cuts installation time. A disadvantage is that adhesive cartridges are expensive. Also, adhesives can't replace nails in ceiling-panel installation.

In this method, beads of adhesive are applied to studs with a trigger-action applicator like an ordinary caulking gun. The panels are then put into position, but are nailed only around the edges, the adhesive being sufficiently strong to hold the plasterboard panels firmly in the center.

• **Cutting and trim techniques:** The pros generally use a sharp wallboard knife to cut gypsum board, although a saw is sometimes used.

To cut a panel along its width, brace it against a support and hold a T-square or straight edge firmly along the line to be cut. With heavy enough pressure to score into the gypsum, run the knife down the T-square. Always score on the face side of the panel.

After scoring, snap the waste piece back along the scored line. The waste piece will now be held only by the board's paper backing. From the rear, cut through the crease in the backing to remove the waste piece. Never try to tear it off.

To cut a panel along its length, measure down the amount of waste to be cut off, making sure the panel is firmly braced from the rear. Using your fingers as a guide for the ruler, hold the knife against the tip of the ruler and move ruler and knife along the panel. Use firm pressure to cut into the panel. Then, as you did before, snap back the waste piece and cut it off from the rear.

No pro takes time to pre-cut cutouts for heat ducts and electrical fixtures. They use one of two methods.

Guided by the measurements that were marked on the floor before the panels were installed, they draw the cutouts on the panel with a pencil and ruler. They then score along the lines with the plasterboard knife, knock out the cutout completely with a hammer and trim the edges.

However, there's an even quicker way. Again, using the measurements on the floor, locate the center of the fixture and whack the center with a hammer, making a hole right through the plasterboard. Using a keyhole saw, cut up or to the side until you hit against the fixture. Now, use the fixture's edge as a guide to saw around the opening. Then, knock out waste with a hammer. After cutting, edges are trimmed off with a plasterboard knife or saw to remove loose particles.

The same principle applies to doors and windows—don't take time to pre-cut openings for them. There's a faster and easier method. Just nail panels in place right over the framed opening. After each panel is up, saw upward or downward along the side edge of the opening, using the edge of the frame as a guide. When the sides have been cut, pull out the waste piece slightly to create a bend along the top or bottom edge. Score along the bend with your knife, lining up the knife by eye with the frame. Now break off the waste piece.

gives a neater job

Not only does this method take less time than measuring and pre-cutting, but it also gives a neater looking job since you'll get a perfect, one-piece fit around windows and doors.

Scrap pieces of plasterboard, by the way, can be used where small pieces are needed to cover narrow areas, as around arches and doorways.

Speaking of arches, you may have one that has to be enclosed. But how is plasterboard going to curve to fit an arch?

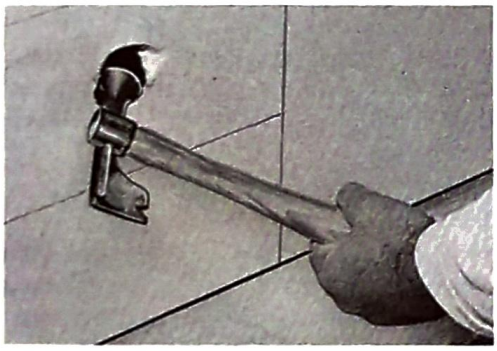
Easy—just cut the piece to the size you need and score it across the back about every 3 to 4 in., or less, depending on the radius of the required bend. Any creases that may appear when the bent piece is applied can be filled with joint cement.

A word, now, about two important items you'll need—nails and corner bead.

There are two types of nails—those with smooth shanks and those with ringed shanks (called annular ring nails). The pros can't seem to agree on which type to use. The straight

1 Mark location on the floor under the register. Top numeral is the distance from the floor to the bottom of the register. Bottom numeral is the distance from the floor to the top of the register. Two lines show edges of the register

3 With a keyhole saw, cut straight up and down until you hit the edges of the register. Next saw around the entire inside of register, using the edges to guide the saw. When cutting is done, knock out pieces with a hammer



2 After the panels are up, use floor marks to lay out rough outlines of the register on the plasterboard. Then knock a hole in the center of the register area with a sharp hammer blow, making a hole for the insertion of a saw blade

4 Finally, use your plasterboard knife to trim the cut edges and to remove any stray pieces that cling to the paper backing. This operation is not critical, as the flange of the register cover will hide the cut edges from view

MAKING REGISTER CUTOUTS

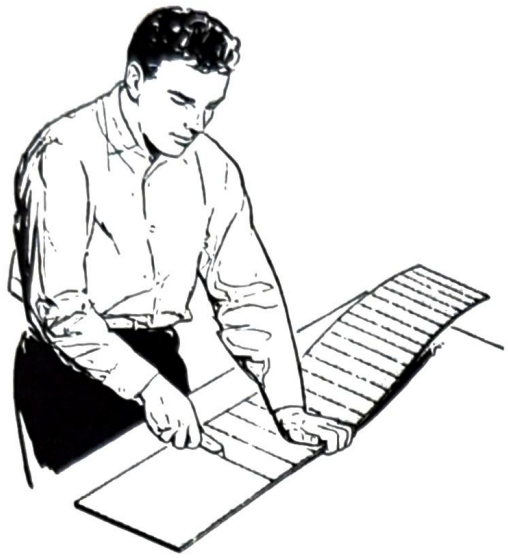
shanked nail does a good job. The annular ring nail, with its greater holding power, is designed to cut down on nail popping. But either type will pop if the drywall is not properly applied.

The other product, corner bead, is nailed to outcorners after panels are up to trim off and protect the corners. Again, there are two general types. One is all metal; the other has a metal center with perforated tape along both sides.

Which one do you use? Again, it's a matter of preference. We feel if there are children in the home who seem to take delight in knocking into corners, the all-metal will provide maximum protection. It's slightly more expensive than the metal-tape combination.

Now you're ready to tape the joints. But, before starting this phase of the job, remember that careless taping can make an otherwise professional-looking drywall job appear amateurish.

You start, of course, by buying supplies. When doing so, note that you'll see two products on your dealer's shelf which are often confused. One



Bending plasterboard to fit inside an arch is similar to bending plywood. Score the plasterboard across the back every few inches, depending on the radius of the bend. When the board is nailed up, angles that show can be smoothed with joint cement

is called joint cement, the other Spackle. You want joint cement. It's used, in conjunction with paper tape, to fill and conceal joints between panels of drywall, cover nail heads, etc. Spackle is made for repairing cracks in finished walls. It should never be used in place of joint cement.

Joint cement, incidentally, comes in powder form, to be mixed with water, or pre-mixed. Powdered cement is less expensive than the ready mix and can save you a few dollars when you have to finish an entire room. But the ready mix is easier to use. It goes on smoothly and sets up more smoothly than the powdered form. If applied carefully, it eliminates a sandpapering step between applications.

Another product you'll need is the paper joint tape mentioned before, which is used to cover joints between panels and in inside corners.

As for tools, you'll need a 6-in. broad knife to apply the cement, and an 11-in. spreader-knife for feathering out the edges of the cement. Two optional but handy tools are a 14-in. plasterer's trowel and a cornering tool. The former can be used in place of the 11-in. spreader knife for feathering joint cement, while the latter simplifies the job of smoothing inside corner joints. Finally, if you use powdered cement instead of pre-mixed, you'll want a wooden paddle or a potato masher to mix it with, and an ordinary bread pan in which to mix it.

Once you've purchased all the above items, you're ready to begin. Assuming you've bought powdered cement, the first step is to mix it. Don't take this step lightly, as it's more critical to good results than most people realize. The container or pan you mix it in must be clean. Note the water-to-powder ratios given on the package of compound and follow them to the letter. Use lukewarm water. Add the powder to the water and stir vigorously with the mixing paddle, or mash with the potato masher for several minutes. Make sure all the compound is uniformly wet. If you prefer mechanical mixing, you can buy electric-drill attachments for this purpose. But don't use them at drill speeds of over 400 rpm, or you may whip bubbles into the cement. After mixing, allow the compound to sit and soak for about 30 minutes. This gives the material a smooth texture, free of lumps.

Generally, the mixture should be as smooth as soft whipped butter. To test for proper consistency, scoop up some compound on your 6-in. broad knife and turn the knife over. If the compound sticks for a few seconds before dropping off, you know it has good consistency. If it's too tacky it will adhere for a long time before dropping off. If too thin it will run off like cake batter. In either case, don't try to "doctor" this batch. Mix up a new one.

By the way, joint cement should be mixed, used and allowed to dry at temperatures of no less than 55 deg. F.

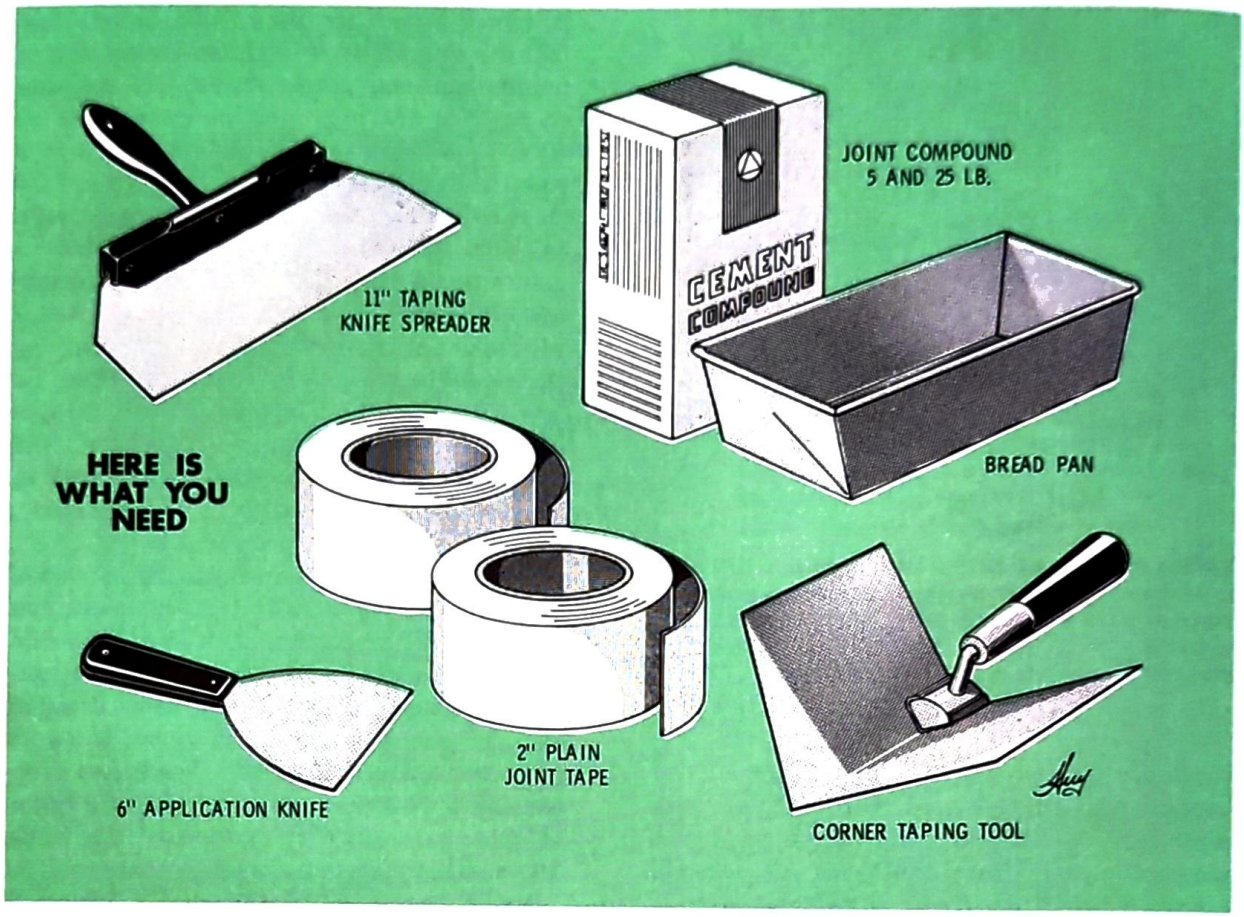
now for the taping

To begin the taping operation, take your 6-in. broad knife and run it across the nails in the drywall. If any project above the surface, they'll scrape against the knife. Drive them home, leaving a dimple in the plasterboard.

Now, start at the flat joints. (A flat joint is formed by two panels meeting straight-on—as opposed to corner joints.) Each flat joint forms a shallow valley where the tapered edges of the panel meet. Using the 6-in. knife, fill one of these valleys with a good application of joint cement, bringing the cement 1½ to 2 in. out beyond the edges of the valley.

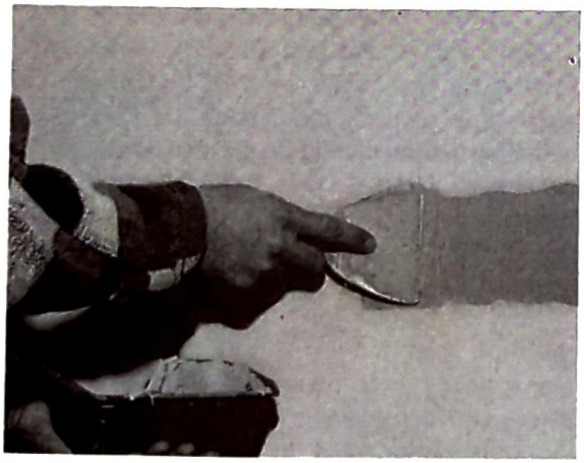
Next, apply tape immediately, pressing it into the fresh joint compound with the knife blade. Use a steady, even pressure. After the tape's in place, apply a covering coat of cement, then draw the knife evenly along the joint to remove any excess compound.

Inside corner joints are almost as simple as the flat joints. First, "butter" both sides of the corner with a good application of joint cement. Use the 6-in. knife, and extend the cement out about

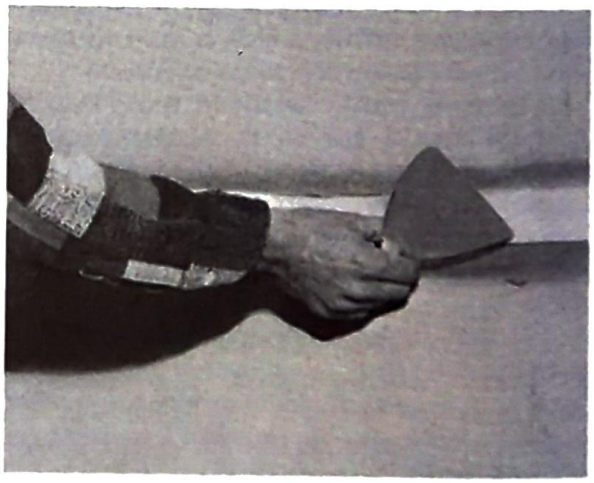


remodel with drywall, continued

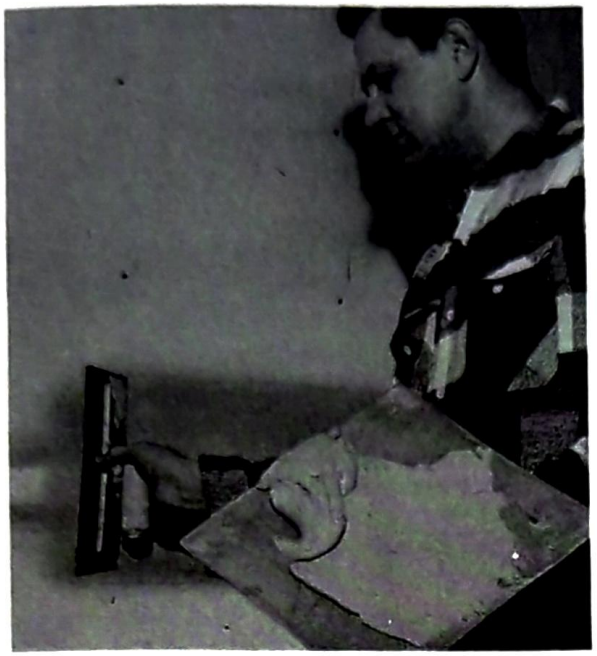
HOW TO FILL AND TAPE JOINTS



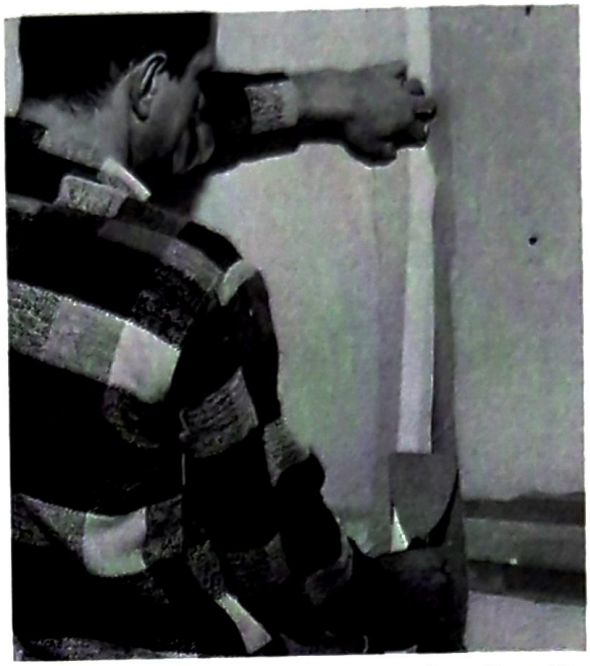
Apply joint cement to the valley formed by the tapered edges of the two adjoining panels of drywall



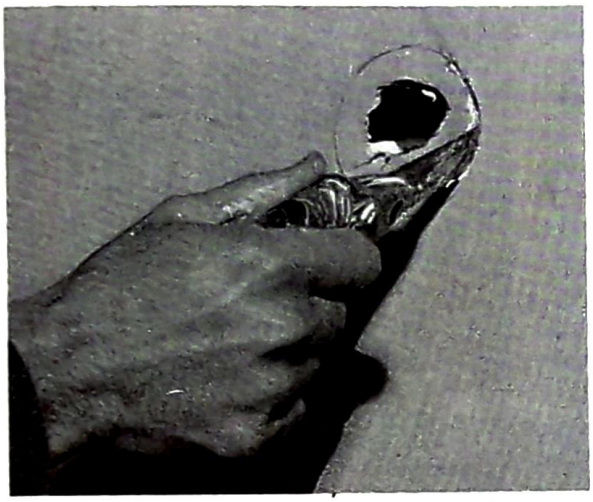
Press the joint tape into the cement with the edge of the applicator knife, then apply more cement



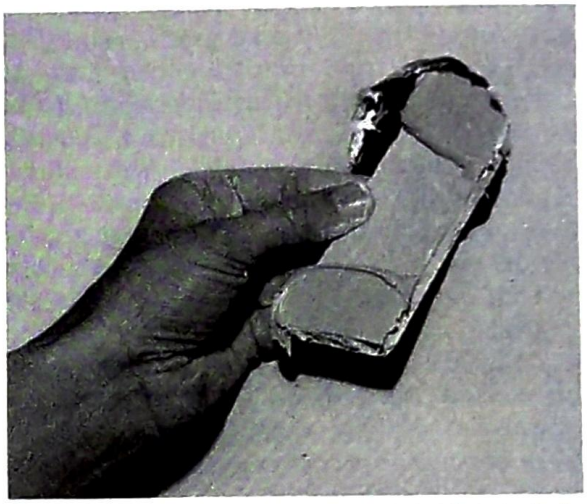
When the cement has dried the next day, apply two more coats of cement, feathering the edges carefully



To tape an inside corner, fold the tape down its center, then press into the corner with a knife or corner tool



The first step in patching a small hole is to draw a 3-in. or larger circle around it, then cut out

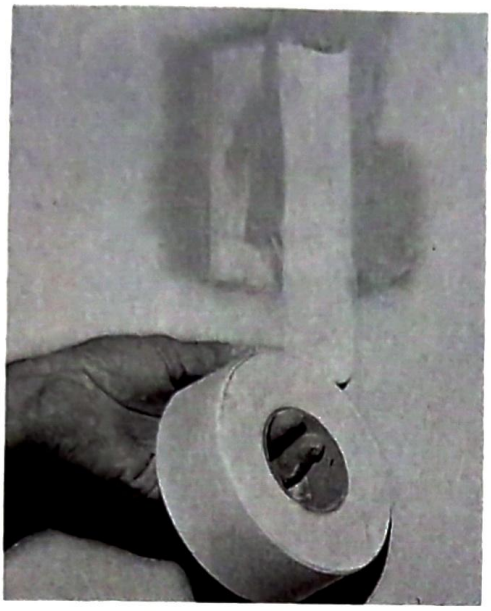


Cut a rectangular support piece to fit behind the hole, "glue" the piece in place with joint cement

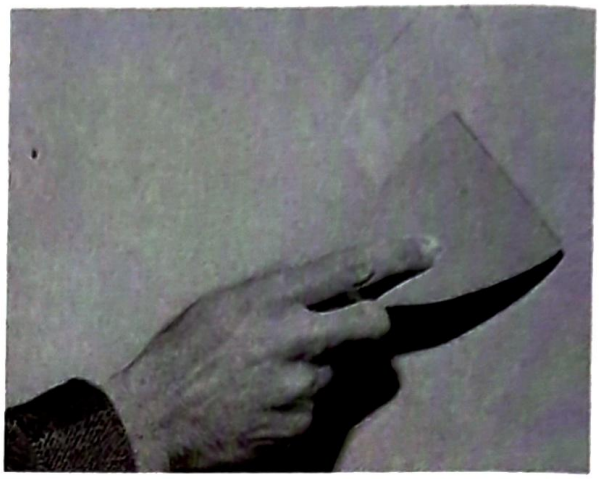
A few hours later, cement a plug of plasterboard to the support piece and allow to dry thoroughly

2 in. to the side of the corner on each wall. Measure off enough tape to cover the corner from top to bottom and fold it down its center. Some tapes are pre-creased for easier folding.

Embed the tape into the cement so the fold falls into the corner, then smooth the tape down its length with the 6-in. knife or the cornering tool. Follow with a covering coat of cement as you did on the flat joints, bringing it out beyond the edges of the tape. This coat may also be smoothed with the knife or cornering tool.



When the patch is dry, cover with joint cement, then apply overlapping strips of tape

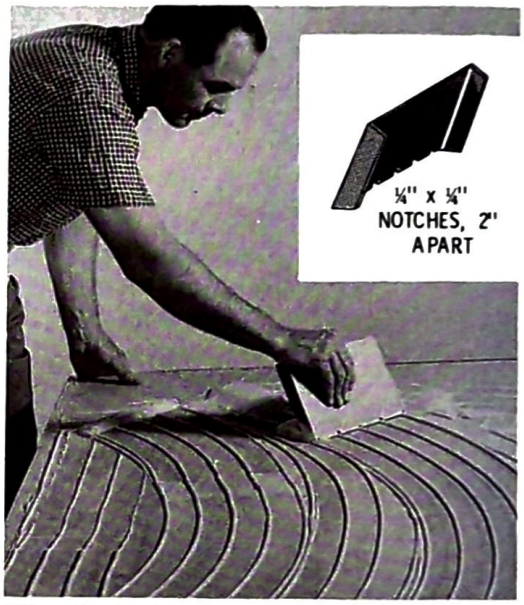


To conceal the patch, let initial coats of the cement dry, then follow with two more coats, as on joints

Next come outcorners. Unlike the joints we've discussed so far, outcorners are not taped. As mentioned before, you will have covered them with corner bead. All you do now is apply a first coat of cement, right over the corner bead.

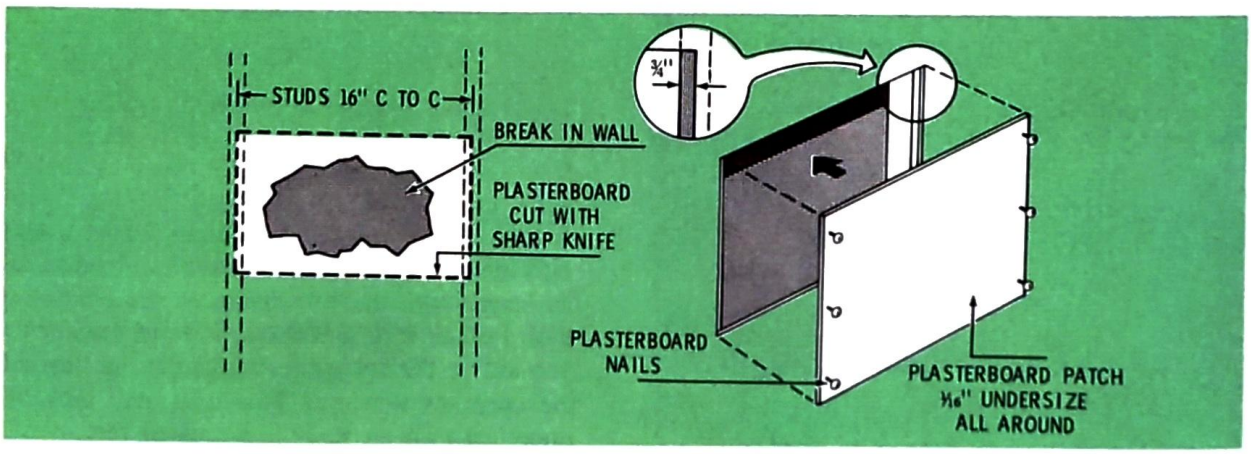
Now you're ready to cover the nails on the surface of the entire wall. Using the 6-in. knife, apply a coat of joint cement over each nailhead. To do this, first fill the dimpled area with plenty of cement, then scrape off the excess. In removing the excess, press hard on the knife to make sure the compound is level with the surface of the drywall.

After treating all nails, let the cement dry overnight. Next morning, if the cement has dried properly, it will have turned from gray to white. Over the nails, it will have shrunk while drying



When laminating plasterboard over old plaster or drywall, spread the joint cement on the back of each panel with the homemade tool shown

HOW TO MAKE A LARGE PATCH IN DRYWALL



to form slight indentations. If any of the cement looks dampish or slightly gray, wait a few more hours before going ahead.

When all cement is dry, mix up a new batch and apply a coat to each joint and corner, using the 11-in. spreader knife or the 14-in. plasterer's trowel. Be sure to feather this coat 1½ in. beyond the edges of the previous coat. Then apply a second coat of cement to the nailheads, using the 6-in. broad knife.

When the cement has again dried thoroughly, sand all the joints and nailheads slightly. Then apply a thin finish coat to the joints and corners, feathering out at least 2 in. beyond the previous coat. Finally, apply a finish coat to all nailheads. Now let dry for the last time and you're ready to paint or paper the walls. Before doing so, it may be necessary to sand all cement once more, to insure a smooth surface.

Now, suppose you've had plasterboarded walls in your home for some time, and they've become damaged. This can happen in one of four ways: (1) nails can pop; (2) cracks can appear due to normal settling, usually extending from a top corner of a door or window frame to the ceiling; (3) holes could have been punched into the wallboard, probably by an active youngster; (4) massive breaks can run practically from stud to stud—usually as a result of heavy impact.

- **Nail popping:** This damage occurs for only two reasons. Either nails weren't hammered in properly when the plasterboard was first installed, or the studs have shrunk, thus squeezing some nails out. The latter condition often becomes apparent during the heating season, in which case, repairs should be delayed until after the heating season. Otherwise further shrinking can occur and, with it, further nail popping. In addition, it's also best to wait until you're ready to redecorate the entire room, since the repairs will deface existing paint or wallpaper.

Start the repair by driving a new 1¼-in. annular ring nail 1½ in. above or below each popped nail. This will provide extra holding power to resist the forces that are working against the nails. While hammering, apply strong pressure with your free hand against the plasterboard to bring the board in firm contact with the stud. Dimple the surface of the board with your last hammer blow, to make sure the head is below the wall surface.

Now drive each popped nail back in, also dimpling the board surface. Scrape all loose cement from around the nailheads—both old and new—and re-cover all nailheads with fresh cement, using the same procedures as previously described for new plasterboard.

- **Cracks:** As you probably know, cracks should be widened and brushed clean to assure a proper base for repair compound. After you've done this, fill the crack with Spackle, which was designed specifically for jobs such as this. Then dampen the Spackle with a sponge to assure a smooth surface when dry. After the Spackle has dried, sand lightly, then apply another coat of Spackle—this time feathering the edges as you did with the joint cement.

This simple repair should prove effective. But remember that cracks can reappear in the future, because filling them does not remove the expansion and contraction of the framing, the vibrations or the settlement that caused the crack.

If a crack keeps reappearing, one sure remedy is not to fill it, but to hide it. Just apply joint cement and tape as you would over a joint.

- **Plugging holes:** Maybe you've read that you can stuff a hole in plasterboard with newspaper or some other material and patch it with Spackle. This method works, but leaves a fairly weak spot that is easily knocked out. The best way to repair a hole, then, is with a tight plasterboard plug. Here's how:

Draw a circle around the hole. Make sure the circle is at least 3 in. in diameter—larger, of course, if the break is larger. Anything smaller than 3 in. wouldn't allow you to get your hand into the hole to install the support strip, as you'll see. A coffee cup or container makes a good circle outliner.

With a keyhole saw, cut out the piece outlined by the scribed circle. Then, take a scrap piece of plasterboard having the *same* thickness as the wall, cut a circular plug that measures a bit smaller in diameter than the hole. Cut a rectangular support piece of scrap plasterboard so its length is 2 in. or more greater than the diameter of the hole in the wall and its width a bit less than the diameter.

Now, coat the ends of the support piece with a generous amount of joint cement or contact cement. Insert it into the hole and press it against the back of the wall. Hold it there until it takes hold, then let it dry for a few hours.

Next, coat the back of the circular plug with a generous amount of joint cement and insert that into the hole so it butts against the support piece. When that cement is dry, coat the patched area with joint cement and cover with several strips of joint tape and another layer of cement. Let it dry and coat with another layer of cement,

sanding beforehand if necessary. Apply still one more coat of cement, let dry, sand if necessary, and you can paint or paper.

• **Massive damage:** Unless you've got a couple of kids who like to see how much punishment household items can take, this type of problem isn't common. However, the repair is a good one to keep in mind should a large area become so badly marred over the years (without an actual break being made in the wall) that no amount of paint will conceal the damage.

Start by penciling a rectangle around the break, making sure each vertical line is drawn over the center of a stud. Cut along the horizontal lines with a keyhole saw and along the vertical lines with a plasterboard knife, but watch out for nails in the studs as you cut and work around them. When removing the damaged piece, pull all its nails from the studs.

Next, cut a piece of plasterboard of the same thickness so that it matches the outline of the piece you've removed, but is 1/16 in. smaller all around. Fasten this replacement panel to the studs with plasterboard nails. Treat all nailheads, and the joints at the edges of the replacement panel, as you did with new plasterboard. Be sure to prime the replacement piece before painting.

new walls over old

If your walls are very badly marred, it may be simpler to cover them completely by building new walls right over the old. This can be done without noticeably reducing the dimensions of the room, with 1/4 or 3/8 in. plasterboard. Depending on the circumstances, you can either nail the new material directly over the old or use the lamination technique. The former method works only over old plasterboard, the latter over plaster or plasterboard.

Before installing the new wall, check the surface. You don't have to patch up every bit of damage, but any high spots or bumps in the old wall which might prevent good contact between new and old should be scraped or sanded down. Loose plaster or wallpaper should be removed and any sizable holes should be patched with Spackle or joint cement. Glossy paint must be roughened with sandpaper.

If you employ direct nailing, you'll want to use a nail long enough to penetrate the studs 1 in. Such a nail is a 6d drywall type (1 7/8 in. long). Space nails 8 in. on wall, 7 in. on ceilings.

Possibly the toughest part of nailing plasterboard over an old wall is locating studs. You can probe beneath the surface of the wall with a nail to find a stud at a corner of the room, then keep in mind that normally studs are spaced 16 or 24 in. apart, center to center. Or you can buy one of several stud locating devices.

If you decide to laminate the new plasterboard, plan the job with an eye to all possible minimizing of the amount of taping and nailing you'll have to do. Then cut each panel to fit, if necessary, and lay it face down on a pair of sawhorses. Now spread joint cement over the back of the panel.

Install the first panel by pressing it into place. Use heavy pressure to insure an adequate bond. Now, install the next panel, making sure the joint between the two is tight. To hold panels in place until the adhesive dries, take several pieces of scrap plasterboard and lay them over the joint. Drive 8d common double-headed nails through the scrap piece and right into the joint. Any mark left by the nails will be covered later when you tape the joints. Three pieces spaced evenly along the joint are enough. Remove them after 24 hrs. and tape the joints.

• **Specialty drywall materials:** In this article, we've been concerned with standard, unfinished plasterboard. However, we wish to acquaint you with some types which have specialized uses.

One is a 3/8-in. material that comes with a wood-grain finish. Walnut, cherry and teak are among the grains available. Such panels cost less than comparable grades of wood paneling, and are installed with matching precolored nails.

prepainted plasterboards

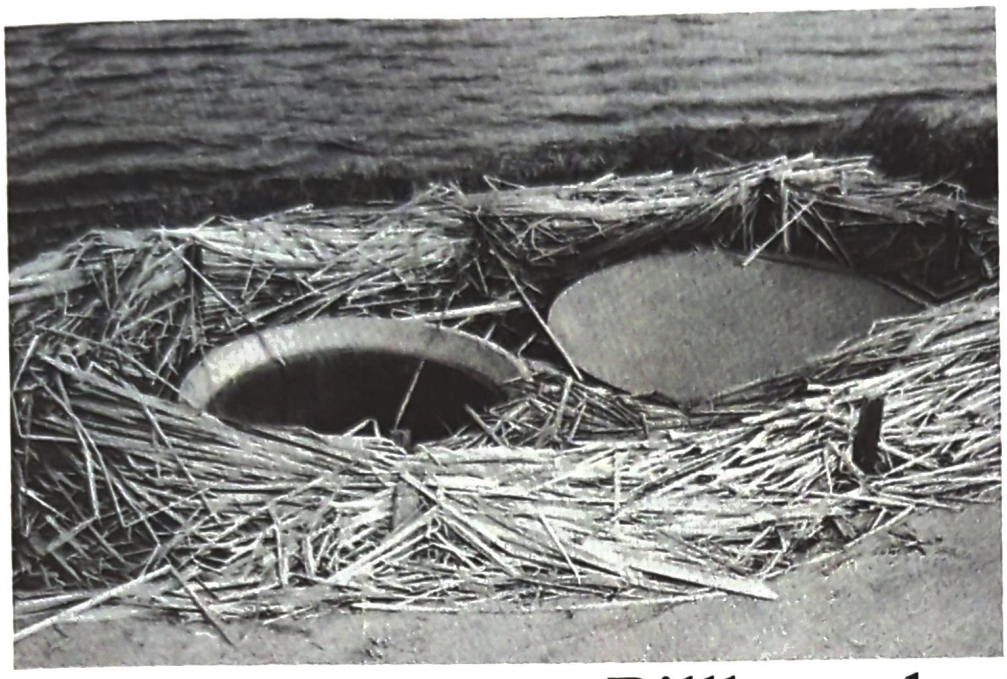
Another specialty plasterboard comes with a factory-applied pastel finish that's comparable to one coat of semi-gloss paint. By installing this product with matching nails and moldings, you can save a paint job.

Insulating plasterboard is standard plasterboard with a covering of aluminum foil on the back surface, to serve as a reflective insulation and vapor barrier.

Vinyl-surfaced backerboard is a waterproofed plasterboard that is applied as a base material for ceramic tile and plastic tile near bath tubs and in shower areas.

Pre-decorated vinyl-surfaced plasterboard comes with a colored vinyl overlay that has a textured finish. Applied with adhesives and colored nails and moldings, it needs no painting, and can be cleaned with soap and water.

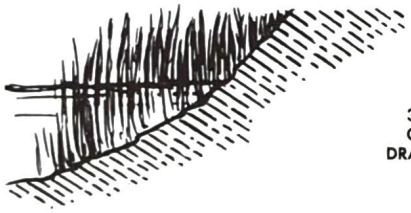
See also: electrical wiring; hardboard; paneling, hardboard; paneling, plywood; paneling, wood; plywood; remodeling shortcuts; walls.



Pillbox duck blind

By HI SIBLEY

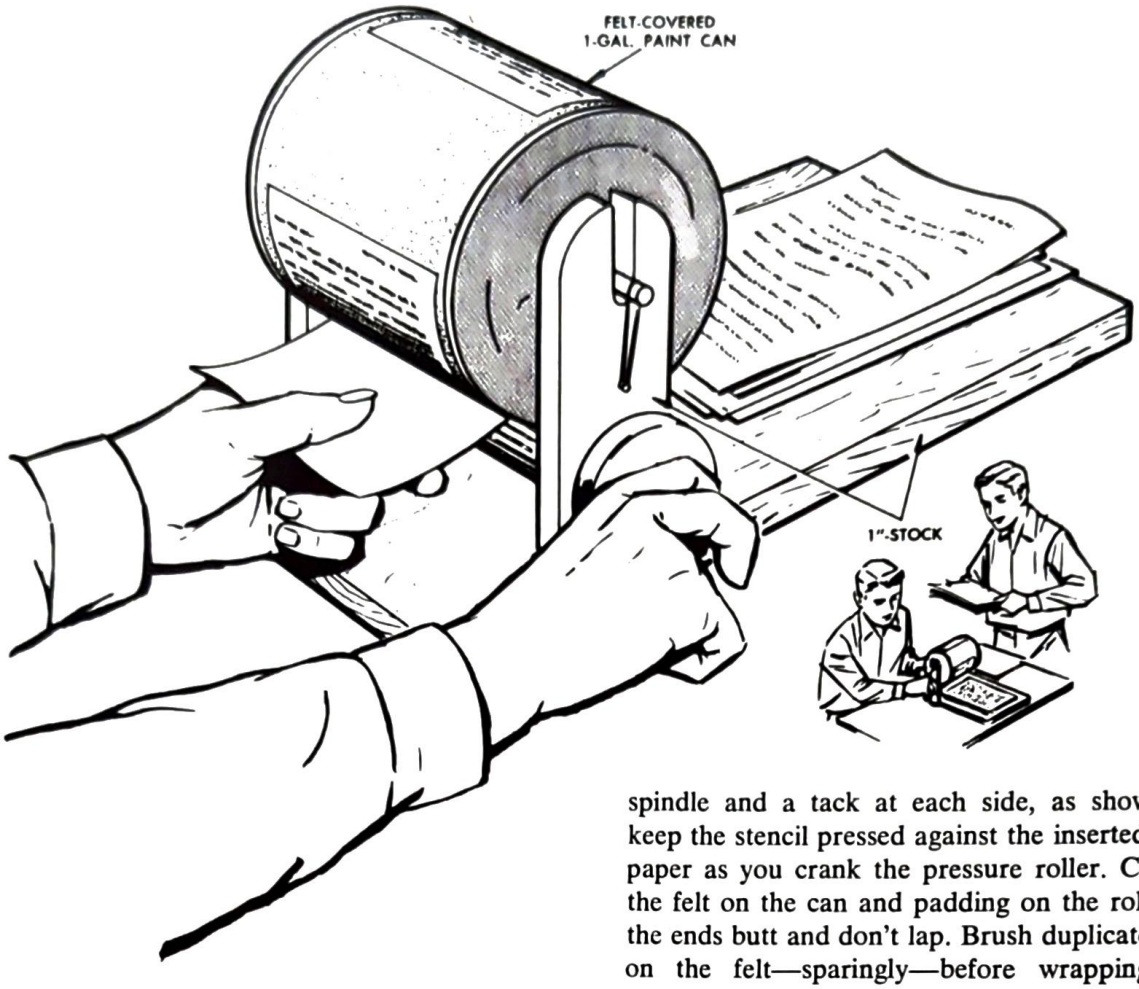
A COLD WIND slants a drizzle across the marsh and you're waiting, waiting for those wary greenheads to drop down to the decoys. They're out of handy gun range and they take their time. That's when you'll be glad you're sheltered in this pillbox blind. It keeps you out of the weather, out of sight, and gives you a gun swing of 180 deg., which is about all any wildfowler can ask. Everything you need to know about building the blind is detailed at the right.



CHICKEN WIRE TACKED TO LIGHT-WEIGHT FRAME AND ELEVATED BY STAKES
CATTAILS OR REEDS
36" x 42" CONCRETE DRAINAGE TILE
CONCRETE OR TAMPED GRAVEL

See also: ammunition; boots; decoys; marksmanship; shotguns; tents.

duck decoys: see decoys
duplicate work: see woodworking

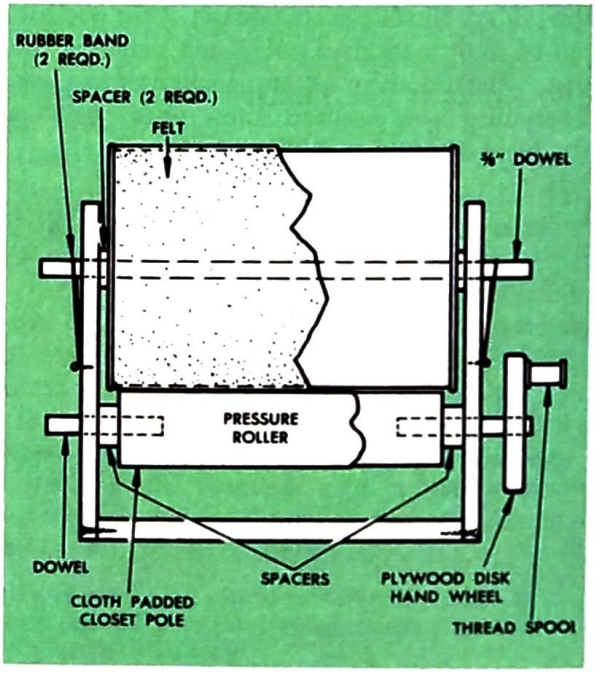


Toy mimeograph really prints

BY TREVOR HOLLOWAY

A FELT-COVERED 1-gal. paint can forms the stencil drum, and a short length of cloth-padded closet pole is the pressure roller for this toy duplicator. Drill holes in the centers of the can ends to take the dowel, and glue shorter spindles into holes drilled in the pole ends. The two side supports are drilled and slotted to receive these four spindles. Loop rubber bands around the drum spindle and a tack at each side, as shown, to keep the stencil pressed against the inserted copy paper as you crank the pressure roller. Cement the felt on the can and padding on the roller so the ends butt and don't lap. Brush duplicator ink on the felt—sparingly—before wrapping the stencil around the drum. Stencils purchased at stationery stores can be trimmed to fit the roller.

See also: boy's projects; copy machine; games, children's; magic; stage coach; stilts.



dwell meter: see cam-dwell meter
early American design: see cobbler's bench; rocking chair; settle; spice chest; spice racks; spinning wheel; tables
earphones: see phonographs; radios, auto; tuners, FM

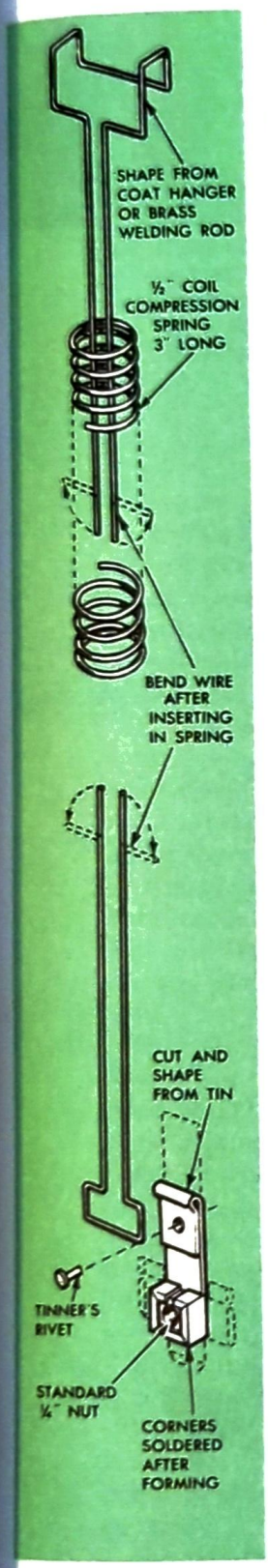
Tripod becomes an easel

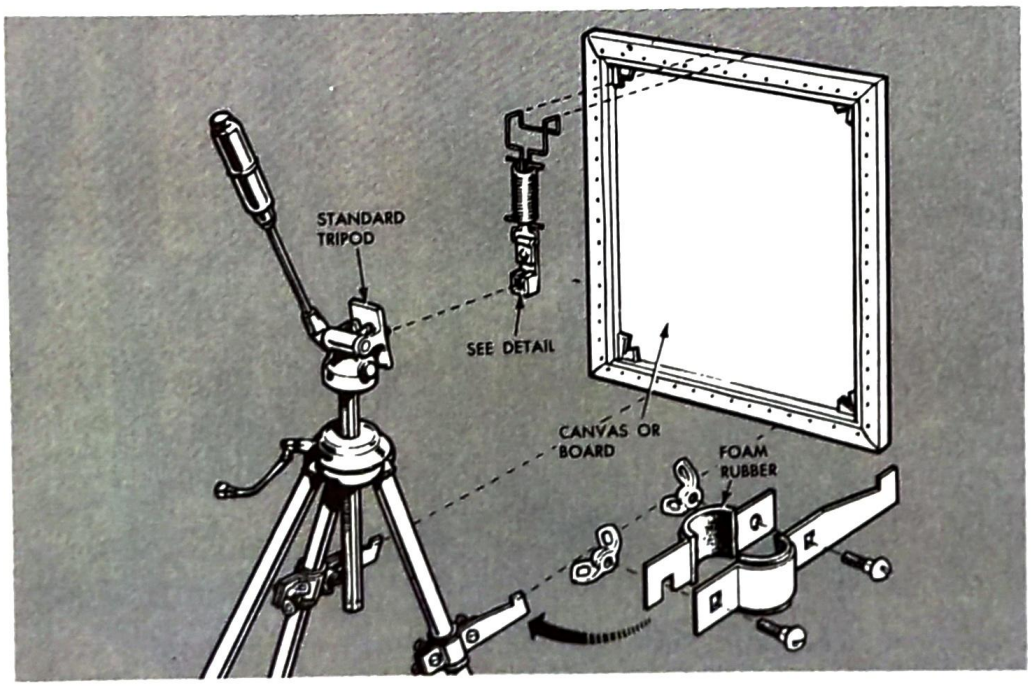
BY PHILLIP C. RADCLIFFE

This easel, made from a standard photographic tripod, is easy to make and provides a sturdy base for an artist's canvas

CAMERA FANS with a yen to dabble in oils don't have to buy an artist's easel. They already have the makings of a dandy one—their camera tripod. The change-over requires the attachment of adjustable brackets to the tripod legs and a spring hold-down to the pan head. The details show how the parts are made. The brackets are formed to grip the tubular tripod legs by bending ⅛-in. aluminum around a pipe that's at least ½-in. in diameter to accommodate the foam-rubber lining. Holes for the carriage-bolt heads are filed square. Wire yokes of both hold-down parts pass through a 3-in. coil spring and hook over opposite ends. The upper hold-down end is shaped to hook over the canvas edge. The lower end has a ¼-20 nut to fit the tripod mounting screw.

See also: hobby workspace; tracing projector.


SHAPE FROM COAT HANGER OR BRASS WELDING ROD
½" COIL COMPRESSION SPRING 3" LONG
BEND WIRE AFTER INSERTING IN SPRING
CUT AND SHAPE FROM TIN
TINNER'S RIVET
STANDARD ¼" NUT
CORNERS SOLDERED AFTER FORMING

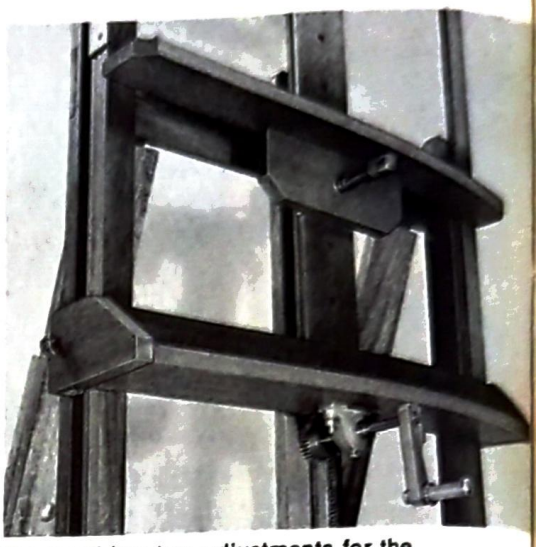


The ultimate easel

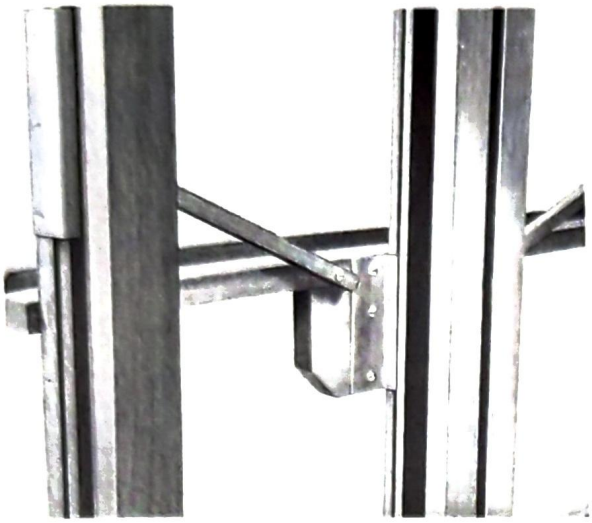
BY MANLY BANISTER

You can build the world's finest for under $50—with a solid mahogany frame and gear-driven elevating mechanism that will adjust for any canvas.

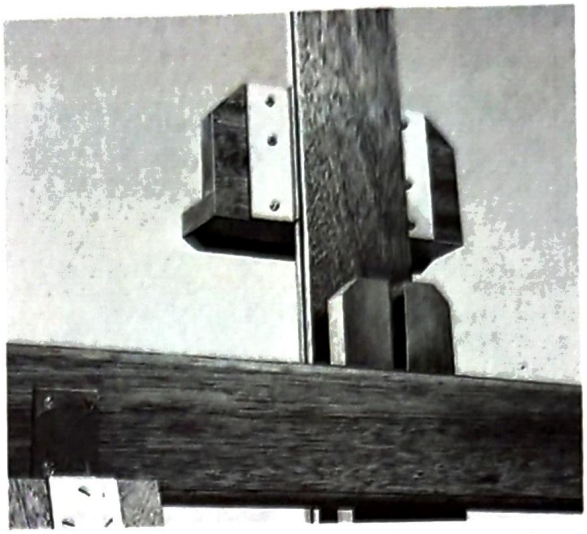
And somehow, with truly professional equipment, painting is easier and more fun



The easel has two adjustments for the height of a painting from the floor. The canvas tray has a semi-fixed position, while the utility tray attached to the carriage assembly cranks up



Rear view of the canvas tray shows pivoting supports for canvases narrower than the carriage frame. The guide rides in a groove in the carriage centerpiece and is held in position with a bolt



The canvas retainer guides ride on the same carriage centerpiece. The retainer is locked on the top of a canvas with a thumbscrew operating against a sheet-brass brake pressed against the centerpiece

IF PAINTING IS YOUR HOBBY, or if anyone else in your family likes to paint, why settle for second best with a commercial easel? This "dream" version is everything an easel ought to be. It's gear-driven in the French style, fully adjustable, and can cost you less than almost any adjustable easel you can buy.

It can accommodate canvases from the smallest up to 4 ft. high—higher if the top retainer is removed and the frame tilted. The adjustability of the canvas tray and the top retainer permits placing the work at the most convenient height for strain-free rendering. A single turn of the crank handle raises or lowers the tray 6 in. The steel gear rack permits 4 ft. of movement for precision placement, whether you paint sitting or standing.

The entire easel was built of mahogany. Any other choice of wood, such as maple, is likely to lower the cost, but it should be hardwood because of the tracking.

The most costly individual element is the rack-and-pinion drive. The rack is ½ in. square by 48 in. long. It has a 16-in. pitch and 14½-deg. pressure angle, as does the pinion, which has 30 teeth, a 1.875-in. pitch diameter and a ½-in. bore. This pitch and pressure angle make it work smoothly. You can buy these gears from your local machine-tool supply house.

Begin with the base, the easiest part, following dimensions given in the drawing on the next page. For a finished look, round or bevel all upper edges.

The rear base spreader should fit in a full lap joint to prevent obstructing the casters. Of the four 2-in. casters used, the front pair should have locks to hold the easel steady. Such a set is available on order from Montgomery Ward.

Side members of the base and the main frame were made by ripping mahogany 2x5s down the middle, producing pieces 1¾ in. by approximately 2¼ in. But check the measurements of the hardwoods you buy and make any necessary adjustments from these figures to insure proper fit.

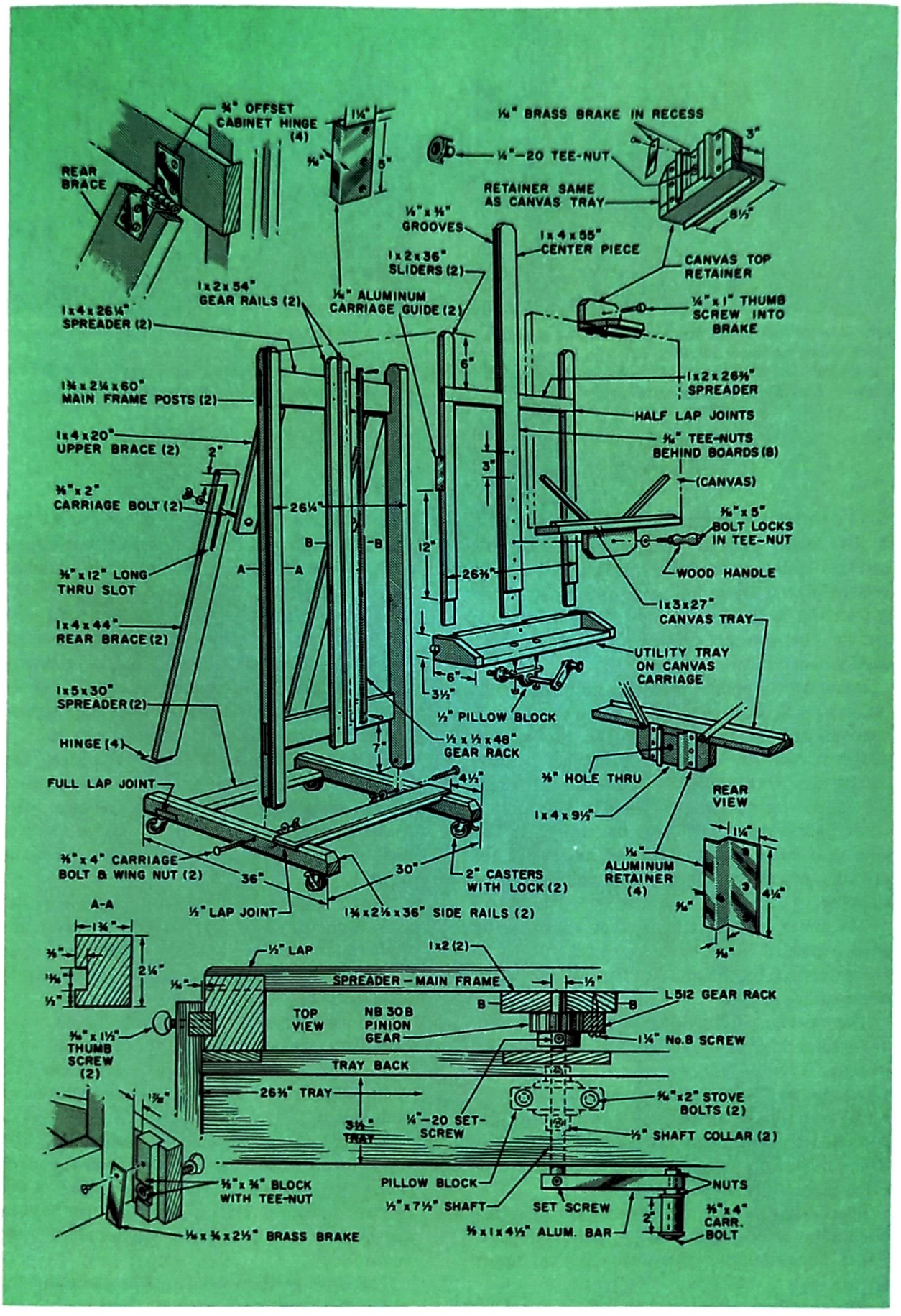
Main-frame side posts are grooved along the length, providing 13/16-in. grooves to accept ¾-in. blocks mounted on the canvas carriage tray. Make the grooves ⅜ in. deep. If you don't have a dado set, trim the posts ⅜ in. and glue on wood strips.

Two 1 x 2s are fastened to the middle of the main-frame spreaders with a gap for the crankshaft tip to ride in. This keeps the pinion gear on the track. Attach the gear rack to the right-hand member.

The main frame is pivoted on the inside of the base with carriage bolts. Combined with rear braces, this permits the easel to tilt back. Use ¾-in. offset cabinet hinges at top and bottom of both braces.

The canvas carriage adjusts three ways. The entire carriage rides up and down on the main frame; the canvas retainer at the top rides on the carriage's vertical centerpiece, and the bottom canvas tray can be raised or lowered in 3-in. increments.

The carriage should be as wide as or slightly wider than the main frame. Then the 1/16-in.


¾" OFFSET CABINET HINGE (4)
1¼"
5"
¾"
REAR BRACE
¼" BRASS BRAKE IN RECESS
¼"–20 TEE-NUT
3"
8½"
RETAINER SAME AS CANVAS TRAY
⅛" x ¾" GROOVES
1 x 4 x 55" CENTER PIECE
1 x 2 x 36" SLIDERS (2)
CANVAS TOP RETAINER
¼" x 1" THUMB SCREW INTO BRAKE
1 x 2 x 54" GEAR RAILS (2)
¼" ALUMINUM CARRIAGE GUIDE (2)
1 x 4 x 26¼" SPREADER (2)
6"
1 x 2 x 26½" SPREADER
1¾ x 2¼ x 60" MAIN FRAME POSTS (2)
HALF LAP JOINTS
⅜" TEE-NUTS BEHIND BOARDS (8)
1 x 4 x 20" UPPER BRACE (2)
2"
3"
(CANVAS)
⅜" x 2" CARRIAGE BOLT (2)
26¼"
B
B
⅜" x 5" BOLT LOCKS IN TEE-NUT
12"
⅜" x 12" LONG THRU SLOT
A
A
26½"
WOOD HANDLE
1 x 3 x 27" CANVAS TRAY
1 x 4 x 44" REAR BRACE (2)
UTILITY TRAY ON CANVAS CARRIAGE
6"
3½"
1 x 5 x 30" SPREADER (2)
½" PILLOW BLOCK
HINGE (4)
½ x ½ x 48" GEAR RACK
7"
⅜" HOLE THRU
REAR VIEW
FULL LAP JOINT
4½"
1 x 4 x 9½"
1¼"
⅜" ALUMINUM RETAINER (4)
⅜" x 4" CARRIAGE BOLT & WING NUT (2)
36"
30"
2" CASTERS WITH LOCK (2)
4½"
⅜"
½" LAP JOINT
1⅜ x 2½ x 36" SIDE RAILS (2)
A-A
1¾"
⅜"
2¼"
1⅜"
½"
½" LAP
1 x 2 (2)
¼"
SPREADER – MAIN FRAME
½"
L512 GEAR RACK
B
B
TOP VIEW
NB 30B PINION GEAR
¼" x 1½" THUMB SCREW (2)
1¼" No. 8 SCREW
TRAY BACK
26½" TRAY
¼" x 2" STOVE BOLTS (2)
1⅜"
3½" TRAY
¼"–20 SET-SCREW
½" SHAFT COLLAR (2)
⅛" x ¾" BLOCK WITH TEE-NUT
PILLOW BLOCK
NUTS
½" x 7½" SHAFT
SET SCREW
2"
⅜" x 4" CARR. BOLT
⅛ x 1 x 4½" ALUM. BAR
⅛ x ¾ x 2½" BRASS BRAKE

aluminum carriage guides on the carriage side rails will fit snugly into the 13/16-in. grooves in the main-frame posts, as will the blocks and brakes on the sides of the utility tray.

These brakes lock the carriage at the desired height. Turning thumbscrews through Teenuts applies pressure to the brass plates in the grooves. If you cannot buy the 5/16-in. thumbscrews recommended, make them from 5/16-in. bolts with the heads cut off and wingnuts pinned or soldered on. In all cases, the Teenuts are recessed to permit the brass plates to lie flat when the pressure screws are loosened.

The canvas retainer and the canvas tray have aluminum guides that ride in grooves on both sides of the carriage's vertical centerpiece. The retainer has a thumbscrew through a Teenut bearing on a brass plate. The tray, however, has a hole through the block on which the guides are mounted, with a bolt fitted into a wood handle passing through the hole. Down the center of the vertical centerpiece are holes 3 in. apart, backed up by Teenuts.

Half-inch quarter rounds are mounted on both retainer and tray 1⅝ in. from the rear to prevent the canvas from slipping. On the rear of the canvas tray, affix two pieces of ½ x ½ x 8-in. stock on screw pivots at their bottom ends to serve as additional supports for small canvases.

the drive-gear assembly

Finally, the drive-gear assembly: Attach the pillow-block bearing to the underside of the utility tray, directly lined up with the slot between the two gear rails, using 2-in. stove bolts. Mount the pinion gear ¾ in. from the end of the ½-in. shaft. Mount shaft collars on both sides of the pillow block to eliminate end play.

The aluminum-bar crank is drilled for the shaft ⅝ in. from one end on center and for a ⅜-in. carriage bolt ½ in. on center from the other. The shaft end of the bar is drilled and tapped for a setscrew. The four places on the shaft for the setscrews should be filed flat.

The crank handle consists of a 4-in. carriage bolt fitted with a ¾ x 2-in. dowel. Enlarge one end of the hole to permit the dowel to slip on the bolt's squared shoulder. Place washers at both ends of the dowel. Turn on a nut after the second washer and tighten another over a lock washer on the other side of the crank bar.

The utility tray suggested in the basic design is no more than just a tray. However, if you have storage problems, and want to convert your easel into a complete portable studio for carrying paints, solvents, brushes, etc., you can compartmentalize the tray. The only requirement is that the bottom of the tray cannot interfere with the crank handle.

Tilting of the easel is easily controlled from the rear so that its weight is toward you. Set the caster locks before loosening the wingnuts

You can also utilize the space between the legs of the easel, keeping in mind that they must move freely when you tilt it. You can install a small cabinet on a support between the base members. After completing the easel, determine how much movement the legs will make during adjustment, and how large a cabinet you can use.

Two ready-made metal or wood cabinets, one facing to each side, will provide storage. Then, when you finish painting for the day, you can roll your easel into a closet.

Pressure-sensitive easel for your enlarger

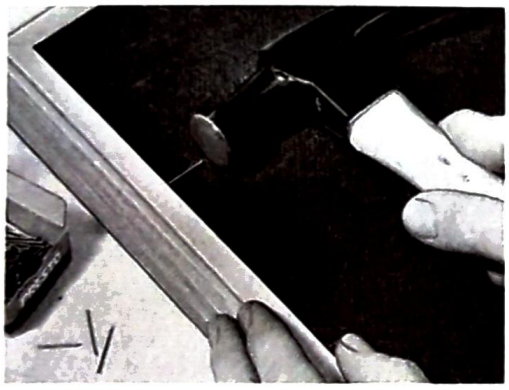
BY WILLIAM FARRELL

THIS ENLARGER EASEL holds printing paper flat, doesn't stain the back, and retains its pressure-sensitive surface indefinitely when kept dust free. The easel, Fig. 1, consists of a picture frame fitted with a piece of ⅛-in. hardboard coated with a pressure-sensitive adhesive that permits you to press the paper lightly into contact and then peel it off after exposure.

Fit the board into the rabbeted back of a 15 x 18-in. picture frame with the smooth face up. Use wire brads to hold the hardboard, Fig. 2. Place the frame on a flat surface and check it with a level, Fig. 4, shimming frame edges with tape if necessary. You must have a level surface for the printing paper. The adhesive is a treated gelatin used in office duplicators. It comes in jelly form which, when heated, becomes liquefied and is sticky to the touch when dry. You will need two cans. Remove the caps from the gelatin containers and place in boiling water until the solution liquefies, Fig. 3. Pour onto the easel as in Fig. 5. Tilt the easel to set the liquid uniformly. Allow it to dry at least 12 hrs.

To use, place the printing paper on the easel and press down lightly on the four corners. Make the exposure, then peel the paper from the easel. If the easel surface is overly sticky, condition it by pressing on ordinary paper and peeling it off.

1



2

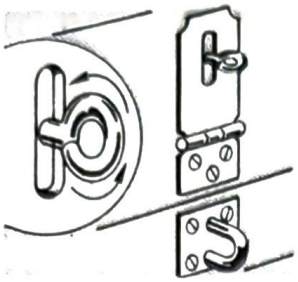
3

4

5

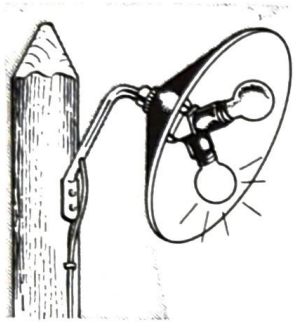
easel-projector: see tracing projector

If a bulb fails to make good contact, you can remedy the situation without putting your finger in the socket by prying up one edge of the contact plate on the bottom of the bulb.



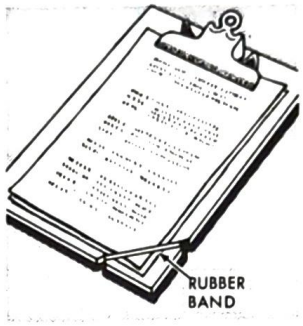
By setting a screw eye into the slot of a hasp on a storage chest or bin, you can prevent the hasp from falling over the staple every time you close the lid.

Storing an extension cord in a drawer? It will store neatly if you coil it in a hank and slip it inside a section of cardboard tube.



You can avoid the inconvenience and possible hazard of a sudden blackout of your yard light if you fit it with a double socket and a second bulb.

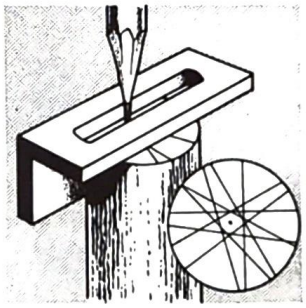
When hiking or camping, take along a spray can of white or yellow paint for marking trails. A quick press on the button leaves a vivid mark on a tree or a rock.



Papers on a clipboard often curl and blow in the wind. To prevent this tendency, cut notches in one of the lower corners of the board to hold a rubber band.

A small magnet on the end of a piece of twine will prevent fumbling in the pocket of your carpenter's apron for small nails and brads. Pin the free end of the twine to the apron.

Keep auto seat cushions in place with an anchor made by threading a heavy string through two rubber balls. Tuck both balls behind or under the seat.



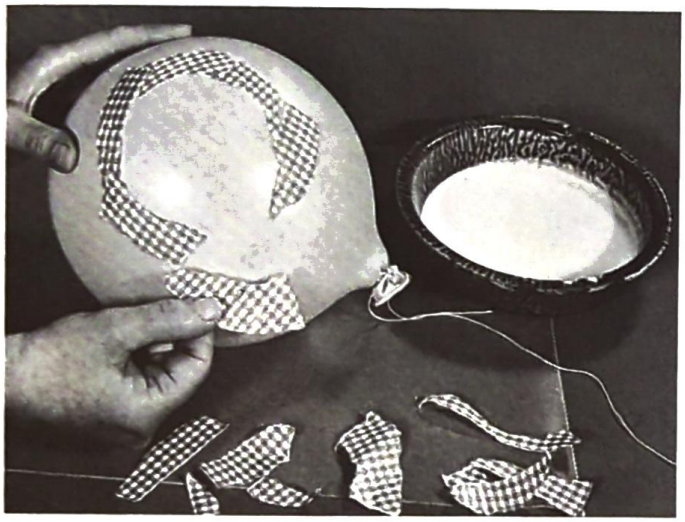
To find the rough center of a rod or dowel, seat a scrap of angle with a square inside corner across the end. A slot in one side adapts the angle to various diameters. Scribe lines along the edge nearest the rod's center, turning the rod each time.

Animated Easter egg

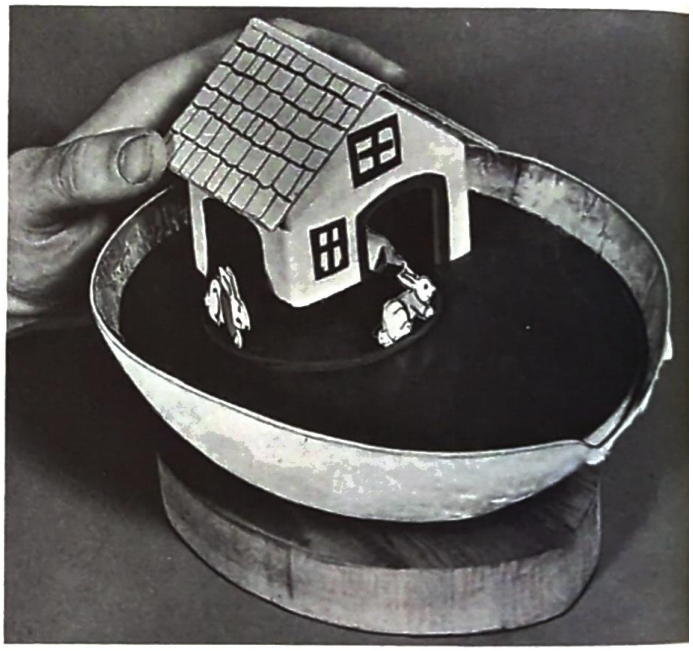
BY WILLARD and ELMA WALTNER

IN THE HOUSEHOLD where this exciting surprise egg is discovered, the Easter rabbit is sure to become as venerated by the small set as is old St. Nick himself. Long old-world favorites, the original eggs were made by constructing tiny scenes inside real egg shells. This giant-sized version is formed of papier mâché over a balloon, and contains an animated scene.

Cover the balloon with strips of paper coated with paste, leaving openings at top and around stem

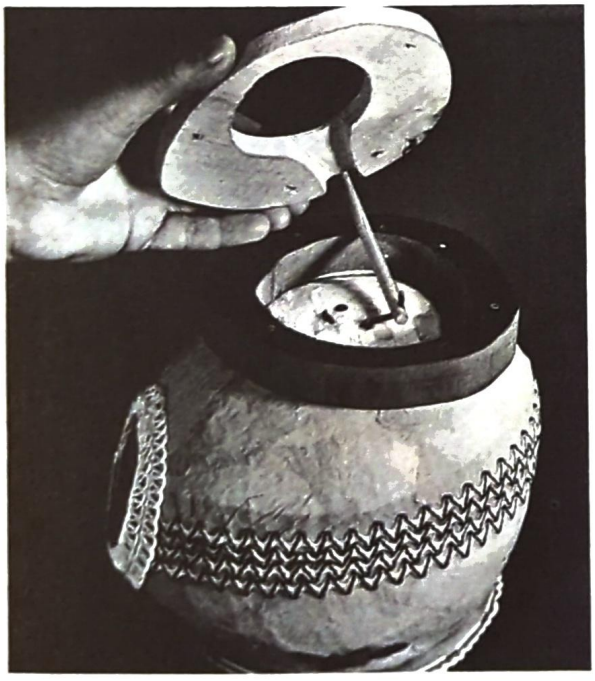


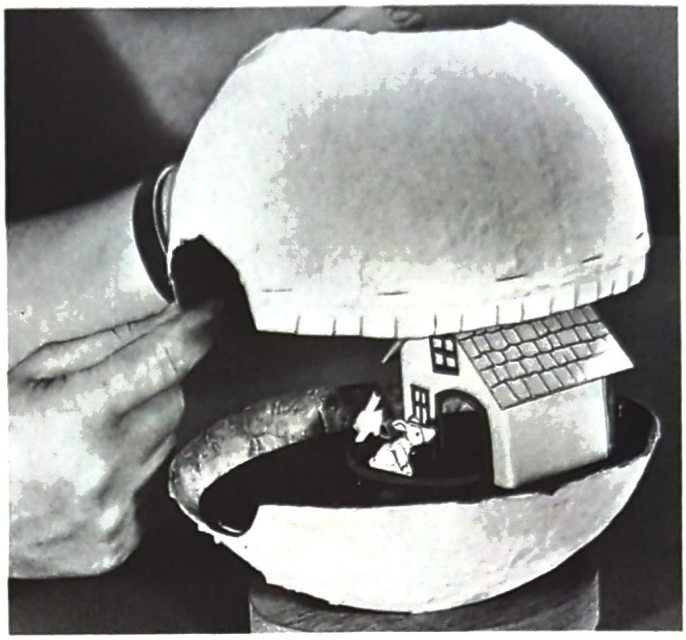
In and out of their neatly decorated house race three posterboard cottontails. The delighted viewer can control the speed of the rabbits by working a dowel handle that operates a concealed crank



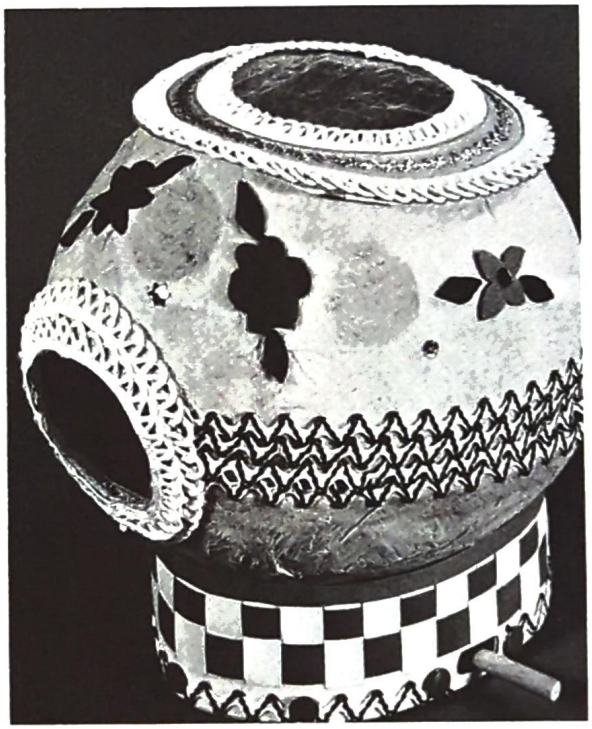
This rotating disk, which supports the three rabbits, is connected to the dowel crank by a length of heavy wire passing through the support. After construction, paint the disk grass-green

The dowel crank has a hole drilled in one of its ends to support the bent end of the 4-inch wire axle. The wire, passing through the support, is bent and stapled to the rotating disk





Constructed from posterboard, this paper collar is attached to the inside edge of the shell top. It helps align the two halves of the papier-mâché egg, and should be shaped to fit it effectively



Decorations are limited only by the materials at hand and the amount of imagination used. House window may be covered with cellophane; green-dyed sponge may be used for trees

The base support is made of two pieces of ¾-inch stock cut and beveled to fit egg shell curvature

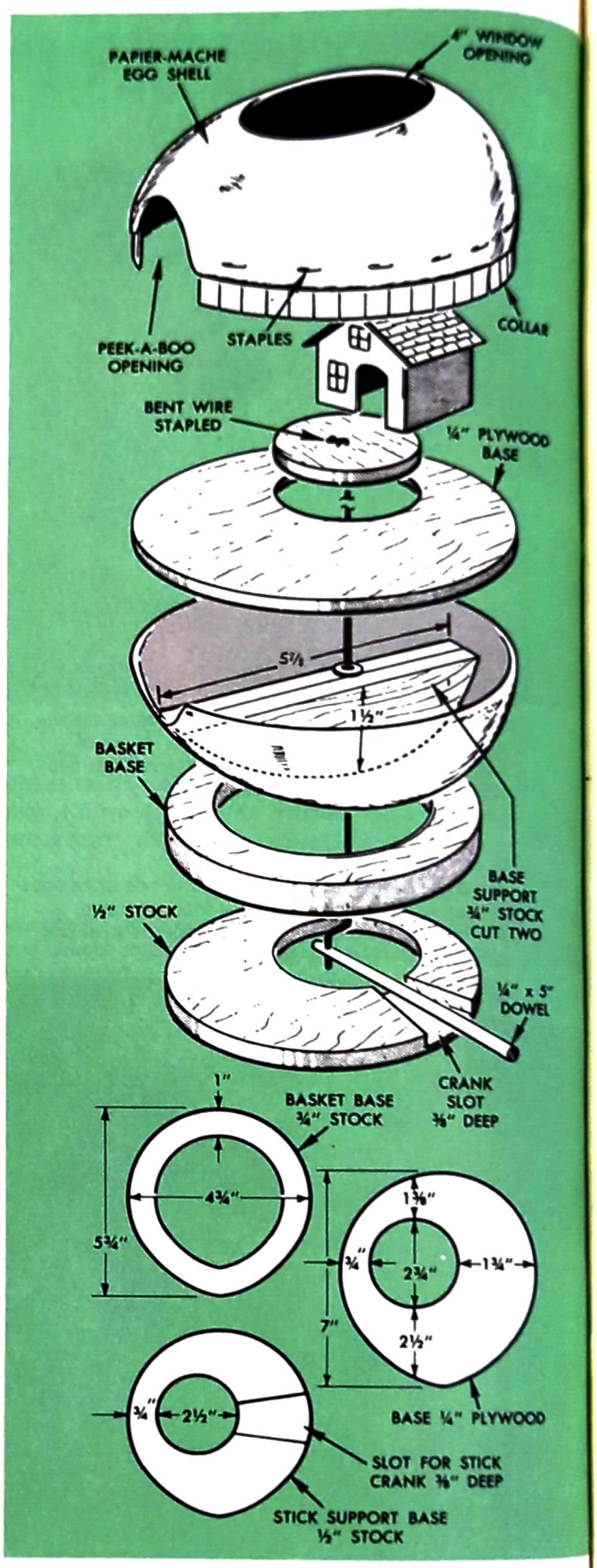
Easter eggs, continued

Begin by preparing a creamy flour paste and a quantity of irregular paper strips. Any kind of paper will do, but since the strips are applied in layers they should differ in appearance so you can tell at a glance when one layer is complete.

Blow up the balloon until it is about 20 in. in circumference and tie the stem. At this size, it will be egg-shaped instead of round. Next brush paste on one side of the paper strips and cover the balloon with a single layer of paper, leaving a 2-in. circle around the stem for the viewing hole and a 4-in. hole at the top to admit light. Continue building up the shell until at least six layers of paper have been applied, then brush a coating of paste over the last layer and put the balloon aside to dry for a day or two. Once the shell dries, deflate the balloon and pull it out.

Before cutting the shell in half, trim the edges of the two openings to make them even. Cut the shell lengthwise, beginning at one edge of the viewing hole and cutting all the way around to the opposite edge of this opening. Make sure that the 4-in. window is centered in the top half of the shell. To make the collar which holds the two halves in position, cut a ½-in. strip of poster-board long enough to fit around the inside of the egg and make ¼-in. slashes in this strip at ¼-in. intervals. Glue and staple this collar inside the edge of the upper half of the shell.

The base support which is mounted inside the bottom half of the shell is made by cutting two pieces of ¾-in. stock to fit the curve of the shell and nailing them together. For a closer fit, bevel



the outer edges of the support slightly. Before fastening the support in place, cut the ¼-in. plywood base to the approximate shape and dimensions given in the diagram, and locate a 2¾-in. circle as shown. When cutting out this circle use a coarse blade so that the saw kerf will be wide enough to permit the disk to turn freely inside the hole.

Drill a hole in the center of the disk large enough for a coat-hanger wire, then cut a 4-in. length of the wire, bend one end to a right angle and slip the wire through the hole. Use a staple to fasten the short bent portion of the wire to the disk. Now place the base on the base support in the bottom of the shell and locate the point where the wire axle of the small disk should pass through the support. Drill a hole through the support at this point, making it slightly oversize to allow the axle to turn freely. Once this hole has been drilled, you may glue the base and its support in place.

To mount the moving disk, slip a plastic or cardboard washer over the axle wire and push the wire through the hole in the support so that it comes out the bottom of the shell. Using a pair of long-nosed pliers, make a right-angle bend in the wire as close to the outer surface of the shell as possible. Then make a second right-angle bend ½ in. from the first so it forms a crank.

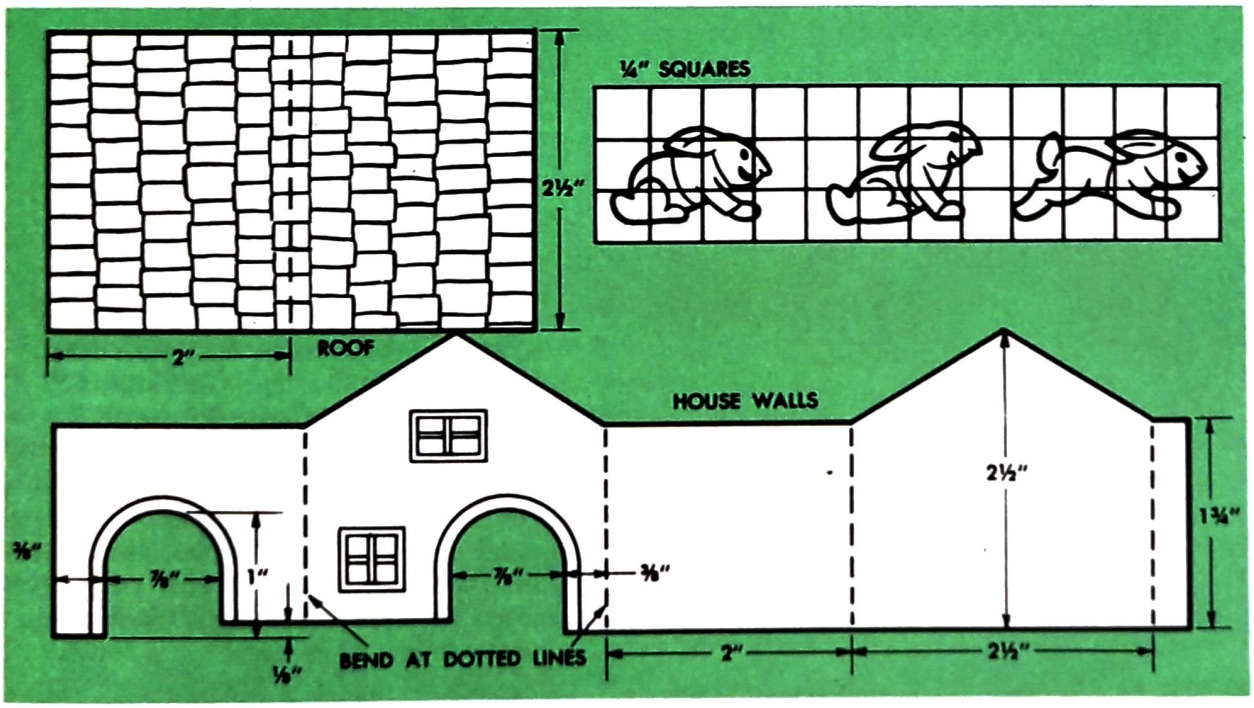
Cut the basket base from ¾-in. stock, shaping the inner cutout to fit the bottom of the egg and allow clearance for the crank. The stick support base has the same shape but should be cut from ½-in. stock. Locate the 2½-in. cutout in the stick support base so that it will allow the crank to turn with approximately ½ in. clearance, and cut the slot for the dowel crank as indicated in the diagram, making it about ⅜ in. deep.

Make the dowel crank from a 5-in. length of ¼-in. dowel, drilling a hole about ⅛ in. from one end for the wire crank. This hole should be large enough so the wire won't bind. Now fasten the basket and stick-support bases together with screws, slip the dowel crank into the slot and glue the base assembly to the shell with the end of the wire in the hole in the dowel crank. Glue light cardboard over the opening in the bottom.

Before mounting the bunnies and house, paint the base and rotating disk green to represent grass. The inside of the upper half should be sky blue, with a horizon of trees and a few clouds added for extra realism. Cut the bunnies from heavy posterboard and the house from a slightly lighter cardboard. After coloring in the details, mount the bunnies with strips of cardboard folded to form triangular supports which hold them upright. Note that the corner of the house which extends over the rotating disk is cut about ⅛ in. shorter to assure clearance.

To assemble the egg, fit the collar of the upper portion inside the edge of the lower half and fasten the two halves with gummed tape. Cover the window with transparent plastic.

See also: Christmas decorations; door decorations; halloween decorations; house decorations; yard decorations.

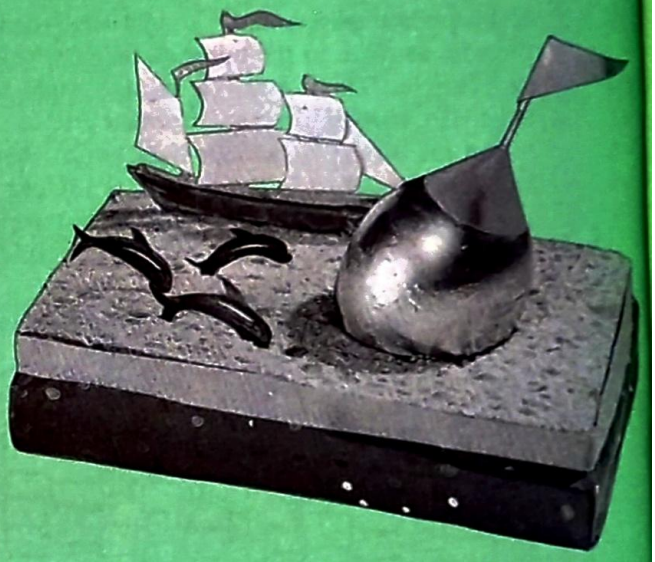


Dress up your Easter eggs

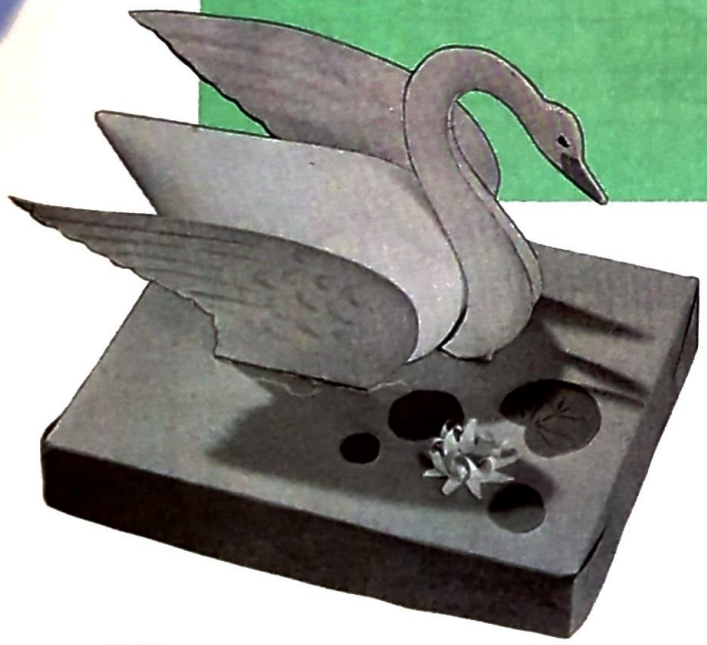
BY HI SIBLEY

Here are six ideas for decorating eggs that are sure to excite your kids on Easter morning

■ THERE'S NOTHING seedy about this watermelon patch, made from an egg and the cover of a small pasteboard box. Cut an opening in the top for the melon, then paint the cover an earthy brown. Next, add vines made by gluing paper leaves to dyed string. Paint the balsa fence a weatherworn gray and mount it as shown. To make the watermelon, dip an egg in light green dye and then add the melon stripes.

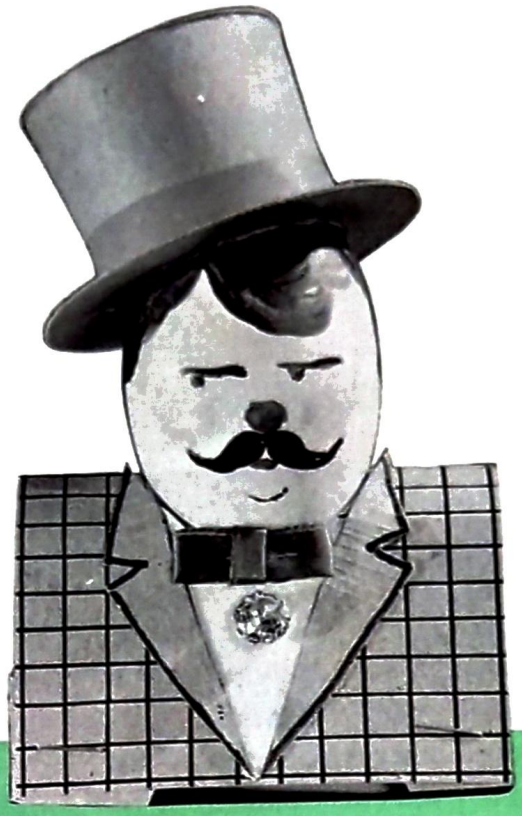


■ FLOATING ON A SEA of green sponge, this brightly colored harbor buoy is sure to please any young egg hunter. Cut out the depression for the egg with cuticle scissors and slip the bristol-board ship and porpoises into slits cut in the sponge. Use flat toothpicks to brace the masts. The egg-buoy is topped with a paper cone which supports a toothpick.

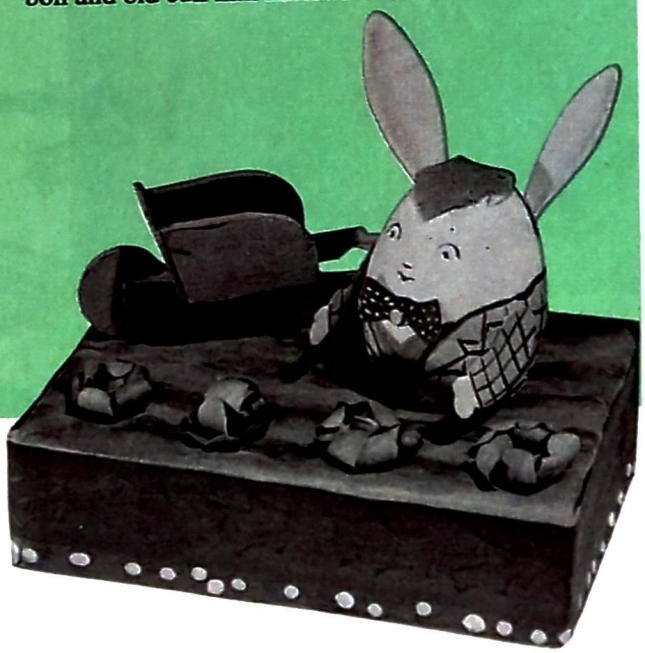


■ THIS FRAGILE white swan has bristol-board wings with pale blue markings. Glue azure construction paper over the cover of a small box, then add a cutout to hold the egg and slits on either side of this for the wings. The neck is a double thickness of bristol board glued together at the head but spread apart at the bottom. A paper cone serves as a tail. Lily pads are green construction paper, and the lily is made from three pieces of thin, white tissue.

■ REAL LACE decorates this Easter maid's festive costume, made from a truncated paper cone. Her paper hat requires more of this lace, plus cheery paper flowers, birds and pipe cleaners. That silky hair peeping out from under her hat may be a piece of wool from a floor polisher or simply painted on with watercolors.



■ DIAMOND JIM is an egghead in a gray pasteboard suit. To make the base, ink in checks on a rectangle of gray pasteboard and bend it into a U-shape, attaching the two ends to each other with a strip of paper. Cut an oval hole in the top to hold the egg, then glue on a white paper shirt front and cardboard lapels. The hat is a cylinder with the top wider than the base. A ribbon and old cuff link finished Diamond Jim.



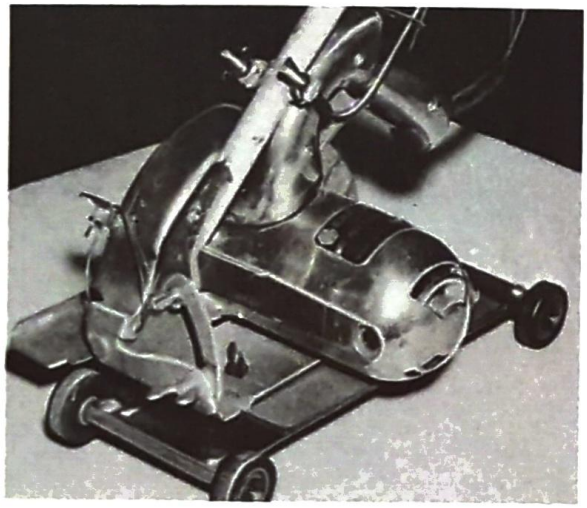
■ PETER RABBIT may bear a strong resemblance to Humpty Dumpty, but those tall paper ears should set any little egg hunter straight. Paint on the jacket and vest, then add the paper arms, tie and cap. Make the wheelbarrow of balsa and the cabbages from green tissue which has been curled by pulling it over the dull edge of a table knife. Cover the cardboard box base with brown paper and add a decorative egg-dotted band at the bottom.

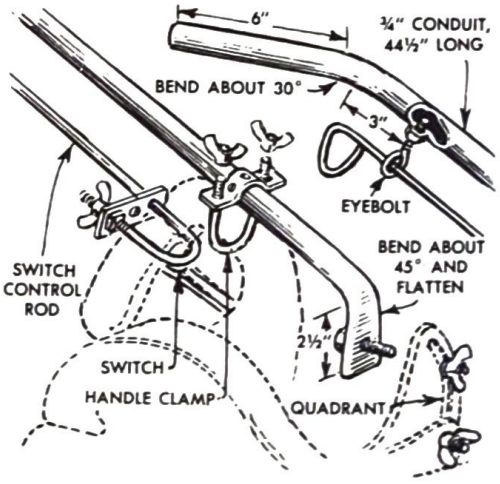
eavestroughs: see gutters

Portable saw becomes a lawn edger

BY GLEN T. PRICE

You can build a handy lawn edger to dress up the sidewalks around your home. All you need is a portable electric saw and a few easy-to-obtain parts





eggs, Easter: see Easter decorations
elbow engine: see engine models
electric appliances: see appliances; blenders, electric; clothes dryers, electric; coffeemakers; electrical wiring; floor polishers; irons; mixers, food; testers, electrical; toasters
electric car: see cars, sidewalk
electric guitar: see guitar amplifier; guitars
electric motors: see solar motors

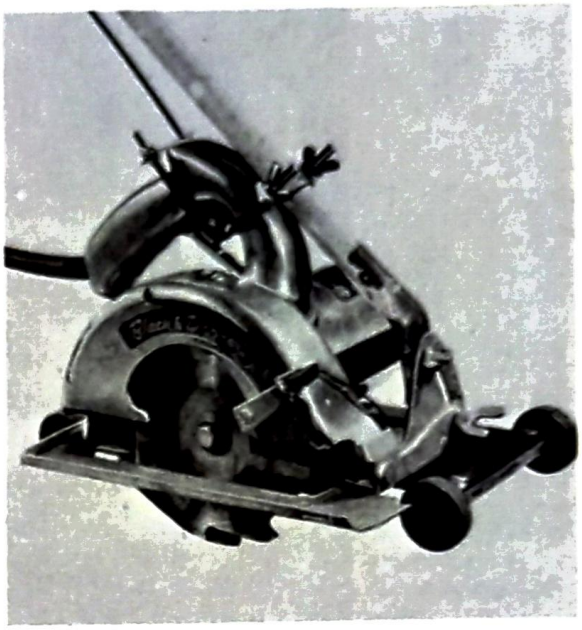
■ YOU CAN CONVERT any portable electric saw, in the popular blade sizes, into a lawn edger by adapting the sketches shown here to your particular model. Attach the improvised stand-up handle and you have a speedy lawn edger. Remove the handle and dolly, change the blade, and you're back in business with a portable saw. Only general over-all dimensions are given for the dolly as you have to make it to fit the saw in hand.

A dulled blade that fits your saw is altered as in one of the details. You can also use a carbide-tipped blade, but don't buy one just for this.

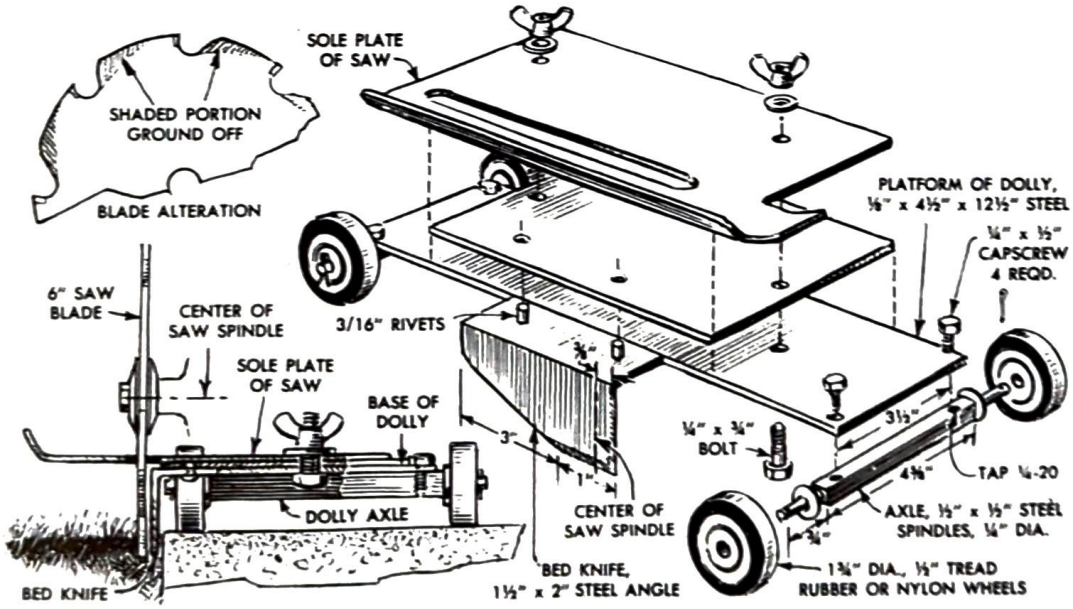
Dolly wheels are given as 1¾ in. in diameter but you may have to use larger or smaller wheels to suit your saw. Roller-skate wheels usually are just the right size and easy to purchase.

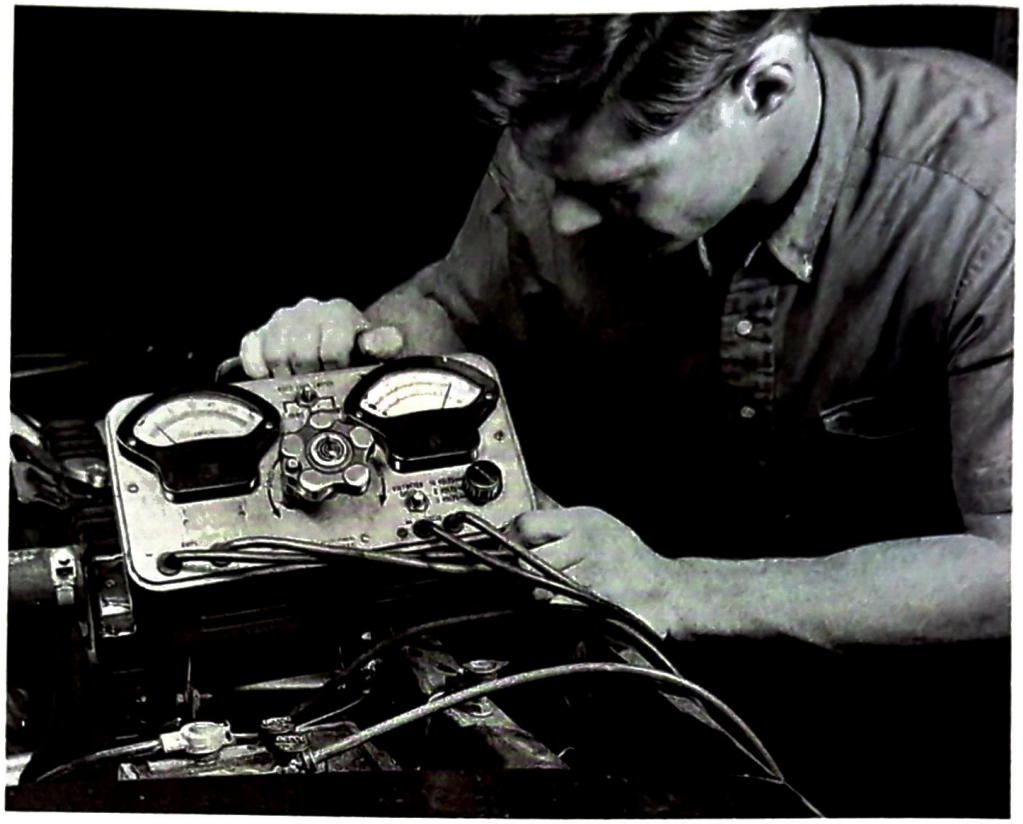
The bed knife is made from a 4-in. length of steel angle, the size of the web being determined by the diameter of the blade. Clearance between the blade and the bed knife should be about ⅛ in. or slightly less. The angle is riveted to the top platform of the dolly. Bolts for attaching the dolly to the sole plate of the saw pass through the sole plate and both platform plates as indicated. Handle and switch control rods must be adapted to the saw you use.

When using the lawn edger, make sure the saw is properly grounded by means of a three-wire extension cord plugged into a grounded outlet, otherwise wet grass could be hazardous. To avoid the possibility of cutting the cord with the edger, or any other garden tool that is powered electrically, it's a good idea to run the cord up over your shoulder and down through your belt in the back. That way the free wire is always behind you, out of the way.



See also: landscaping; lawns; lawn sweeper; leaf blower; mowers; mulchmaker; weed killers.


SOLE PLATE OF SAW
SHADED PORTION GROUND OFF
BLADE ALTERATION
PLATFORM OF DOLLY, ⅛" x 4½" x 12½" STEEL
¼" x ½" CAPSCREW 4 REQD.
6" SAW BLADE
CENTER OF SAW SPINDLE
3/16" RIVETS
SOLE PLATE OF SAW
BASE OF DOLLY
¼" x ¾" BOLT
3½"
4⅛"
TAP ¼-20
DOLLY AXLE
CENTER OF SAW SPINDLE
AXLE, ½" x ½" STEEL SPINDLES, ¼" DIA.
BED KNIFE, 1½" x 2" STEEL ANGLE
1¾" DIA., ½" TREAD RUBBER OR NYLON WHEELS
BED KNIFE



Checking out your car's circuits

BY MORTON J. SCHULTZ

With the right equipment and a few simple tests, it's easier than you think to diagnose ailments of your car's electrical system. But the equipment is essential

electrical testers: see testers, electrical

WHEN YOU HAVE CAR trouble, the first step toward a remedy is locating the problem. And most of the time, the first question revolves around whether you're in deep water regarding the electrical system or the fuel system.

If the car will run at all, you may have some rather involved diagnosis to enter into. But if the faithful steed seems simply to have given up the ghost, it's an excellent bet that your difficulty is electrical. If you're getting any significant amount of fuel at all—that is, if the fuel system hasn't completely collapsed—the car will usually run. Not well, perhaps, but it will usually chug along some way or other.

Let's assume, then, that you have conceded you want to understand the basics of the electrical system. You may well have been told by a crusty old professional mechanic that "fancy gadgets" are an unnecessary waste—that no mechanic worth his salt needs them.

But two irrefutable facts that you should know about automotive electricity—facts you should start with—are these:

- There are no shortcuts to electrical testing. You *do* need "fancy gadgets," as well as a clearly

defined and orderly testing procedure to follow.

• Automotive electricity remains a riddle wrapped in a mystery inside an enigma for many, including many good professional mechanics. Why this should be is anyone's guess. The subject just isn't that difficult to understand.

The wise car buff doesn't wait for trouble to strike before testing his vehicle's electrical system. This system needs periodic attention just as much as tires, carburetor, chassis or anything else.

An electrical component seldom fails completely all at once. Usually, it weakens gradually. Modern test equipment can pinpoint the weakness and allows you to make repairs before you find yourself in a fix. For that reason, it's a good idea to give your electrical system a thorough test-out every 12,000 or so miles.

The electrical system is divided into two main circuits: starting and charging.

The place to begin testing is the starting circuit, which consists of the battery and starter. Obviously, they start the car. Once it's started, though, these parts are no longer needed since the job of providing electricity is taken over by the charging circuit which consists of the generator or alternator and regulator. All circuits, of course, have wires and cables that hook parts together. They can't be overlooked.

storing chemical energy

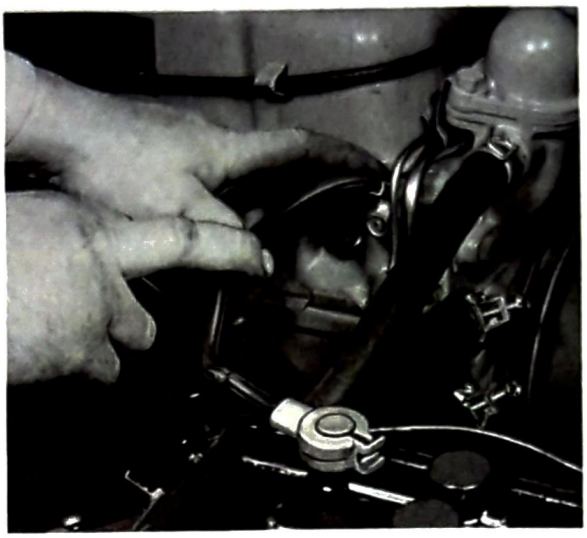
It's commonly, but erroneously, believed that the battery stores electricity. Actually, however, the battery converts electricity it gets from the generator or alternator into chemical energy and stores *that* until needed. Then, when the battery and starter are connected electrically, by the simple action of turning on the ignition key, the battery's chemical energy is transformed back into electrical energy, and current flows from battery to starter to ground, and back to battery —something like Tinker to Evers to Chance.

With most starters, electricity coming from the battery first activates a powerful little device called the starter solenoid, which does two jobs simultaneously:

1. It closes a switch which allows the full flow of current from the battery to enter the starter motor itself.

2. It energizes a plunger-type gadget that pushes forward and drives a pinion gear into mesh with the flywheel. That gear is on the aft end of the armature shaft of the starter motor.

With the pinion gear and flywheel mated, the flow of electricity in the starter motor revolves the armature at great speed. The armature drives the pinion gear, which drives the flywheel. And . . . the engine starts.



The battery ground cable normally is connected to the engine. Before testing it, check the connection to verify that it is tight and free of corrosion

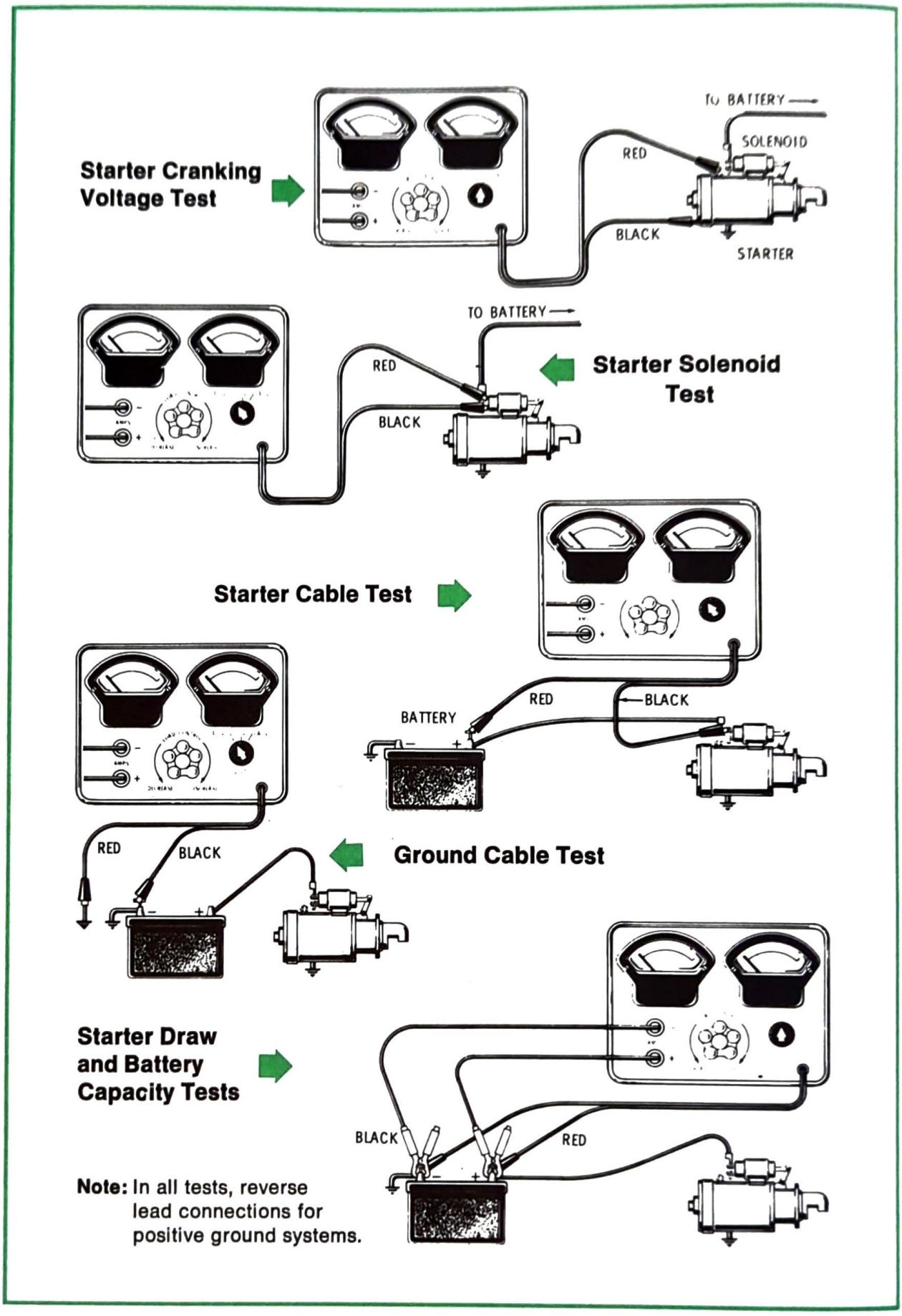
When the engine begins to chug and you release pressure on the ignition switch, you break the electrical connection between battery and starter. With the "pressure" off, a return spring inside the solenoid pulls the plunger back, releasing the pinion gear from the flywheel. Otherwise you'd have one chewed-up gear, a chewed-up flywheel, or both. At this point, the starter has nothing to do until the next time you start the car.

Now for the testing. First, though, let's not kid about one thing. If you're serious about doing your own automotive electrical work, you need the right test equipment. Without it, you can only guess what's wrong with the electrical system—and that's both inaccurate and expensive.

The two basic testers you need are a voltmeter and ammeter. The voltmeter checks electrical "pressure" (volts) while the ammeter checks current flow (amps.).

To simplify things, think of an auto electrical circuit as water flowing from a pump into, through and out of a pipe. The pump (which we can liken to the battery) exerts a force which is usually expressed in pounds per square inch (p.s.i.) against the water inside the pipe to obtain a desired rate of flow. The rate of flow is usually expressed in cubic feet per minute (c.f.m.). In electrical systems, the "pressure" or p.s.i. becomes *volts,* while the rate of flow or c.f.m. becomes *amperes.* The "pipe" is the wiring.

The battery-starter tester shown in this article



Note: In all tests, reverse lead connections for positive ground systems.

is actually a combination unit containing a voltmeter and ammeter, plus a built-in carbon pile (shunt) that allows controlled variation of the current passing through the meters. It permits quick, accurate tests of battery, starter, and cables under operating conditions.

Automotive electrical testing requires a unit similar to the one shown. It need not come in such compact form. It could be a separate voltmeter and ammeter, with an external carbon pile. Whatever the makeup, resign yourself to the fact that it'll cost in the neighborhood of $50 or more. But it's worth every cent.

If you decide to buy a tester, read the instruction manual carefully. Although all testers work basically the same way, and all hookups for auto testing are the same, there are different features from one meter to another, such as scales and the ways to read them. However, the black leads are always negative and the red (or other color) leads positive.

Most cars today, except some foreign jobs, are negative-grounded, so the black leads of the tester will always be connected to ground. However, if your car is positive-grounded, as in many older-model Chrysler products, the red lead becomes the ground lead.

If your car has a generator and you accidentally hook up test leads the wrong way, no harm's done. When you spot the error, simply reverse the leads. If it has an alternator, the wrong hookup could cause irreparable damage since there's a direct connection between the battery and alternator output terminal at all times.

Reversing test leads, even for a second, can short out the alternator output terminal and send full battery voltage back into the alternator, burning up diodes and wiring. For this reason, you must make very sure your hookups are correct the first time.

So much for the background material. Now let's get into the tests themselves.

Here's how to tell whether the battery has sufficient pep for starting:

shunt must be off

Make sure the shunt-control knob is off and connect the leads of both the ammeter and voltmeter as shown in the diagram at left. Turn the shunt control knob toward the "increase" direction until the ammeter reads three times the ampere-hour rating of the battery. This rating is usually inscribed on the battery case.

For example, suppose you have a 12-v. battery rated at 50-amp. hours. Increase the shunt control until the ammeter reads 150 amps. (3 times 50). When this point is reached, wait 15 seconds and read the voltmeter scale. You should get a reading of 4.5 v. or above for a 6-v. battery and one of 9.0 v. or above for a 12-v. battery.

Any battery that meets this test is a good one. If you don't get the required reading, don't bother testing the starter; you'll only get inaccurate results. Get another battery you know is in good shape and recharge the old battery and then do the capacity test again. If still not up to snuff, you need a new battery.

You need to check the starter-cranking voltage to tell you the overall condition of the starting circuit. If the circuit flunks this test, others are needed to find exactly what's wrong.

Hook up the meter as shown on page 874. Connect a jumper lead from the distributor primary terminal to ground on the engine. This grounds out the primary circuit and prevents the engine from starting as you crank it.

Crank the engine and read the voltmeter. (Incidentally, make sure you don't crank for more than 15 seconds for any of these tests. They put a terrific strain on the battery and starter.)

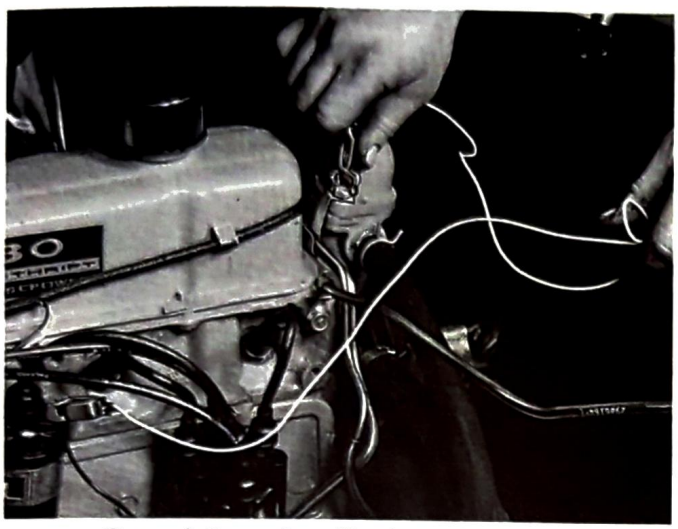
If the starting circuit's in good shape, you should get a voltage reading of 5 or more for a 6-v. system and 10 or more for a 12-v. system. If you get these figures, and the battery capacity checked out, everything in the starting circuit is okay. If not, then you have to zero in on the problem area by testing the solenoid, all cables and the starter itself. Here's how to do this, again using the meter hookups shown on page 874.

keep ground hooked up

When hooking up the meter for a starter solenoid check (see diagram), be sure to keep the jumper wire going from the distributor primary to ground in place. The voltmeter selector scale should be set in mid-range. On the meter in the sketch this is the 20-v. scale. Yours should be about the same.

Crank the engine and read the voltmeter. Turn the voltmeter selector switch to the lowest scale—on the meter in the sketch, that's the 4.0-v. scale. Note the reading and immediately switch back to mid-range before you stop cranking.

What you're looking for is a so-called voltage drop—the difference between what you get on the mid-range scale and on the low-range scale. If that is more than 0.1 v. in a 6-v. system or above 0.2 v. in a 12-v. system, the resistance of



To crank the engine without actually starting it, connect a jumper from the primary side of the coil or distributor to the ground. This will send the coil's current to the ground instead of the plugs

Posts and terminals must be clean before tests are run. Besides preventing accurate readings, dirt and corrosion can simply prevent the car's starting. The cleaning tool shown only costs about a dollar

checking out circuits, continued

the starter solenoid is high. Replace the solenoid. This same test, by the way, can be made with an ohmmeter, if you have one and prefer to use it.

To check the starter cable, hook up according to the diagram and switch the voltmeter selector switch to mid-range. Crank the engine and read the voltmeter. Switch to low-range, read the meter and switch back at once to mid-range, as before.

Again, a meter reading of above 0.1 v. for a 6-v. system or above 0.2 v. for a 12-v. system indicates high resistance. This defect is usually caused by a bad cable or dirt or corrosion on battery post or starter cable terminal. Remove the cable, clean off the post and terminal, reinstall the cable and test again. If the reading isn't better, replace the cable. By the way, make sure all connections are tight. Loose ones can also cause high resistance.

Procedure for checking the ground cable is the same as for the starter cable test, but the hookup is different. Just be sure you follow the right diagram.

Caution: In doing all these voltage-drop tests, the reading you get when the voltmeter selector is in mid-range must be *below* the highest point on the low-range scale. If it isn't, do *not* switch to the latter scale or you'll damage the meter.

For example, with the meter shown in the diagram, suppose you get a reading of 5.0 v. on the 20-v. scale. The low-range scale will only measure from 0 to 4.0 v. So, aside from damaging the meter, you won't even get a reading because that scale won't go high enough.

the starter draw test

Another test in the diagram tells you how much current the starter is pulling and, therefore, whether the internal electrical parts of the starter are in good shape. Starter-draw specifications differ from one starter to another, so you have to get the specs before doing the test. If you don't have a manual, a dealer who sells your brand of car may help you out. You need a voltage specification and a maximum amperage draw spec. But he'll know what you mean if you ask for specs for the starter draw test.

Before hooking up the meter, turn the shunt control knob off and the voltmeter selector switch to mid-range. Don't forget to keep the jumper in position on the distributor primary.

Crank the engine and note the exact voltmeter reading. Stop cranking and turn the shunt control knob to the increase side until the voltmeter reads exactly the same as when you cranked the engine.

Crank the engine again and read the ammeter. This tells you the current draw of the starter. If it isn't the same as that specified, something's wrong inside the starter. Take it off the car and have it disassembled and bench-tested at a shop. At that time, you can decide whether it pays to rebuild or replace it.

Ever notice how a word like "generator" or "regulator" can make an amateur mechanic's

face sag like a used teabag? One reason might be the way the subject is handled in technical manuals. Since these books are written for pros, they tend to dwell on detail and theory, leaving the poor duffer, who only wants to know if his system is charging okay, to cry out in vain for enlightenment.

The procedure for troubleshooting your charging system involves an initial test which tells you whether the system as a whole is operating properly, overcharging or undercharging. If the system passes the test, you go no further. However, if it's overcharging or undercharging, you then have to run three additional tests to find out whether the trouble is in the generator, the regulator or a wire. Simple, isn't it? And to make it simpler, the three additional tests are all run with the same basic hookup as the initial test.

check the system type

But, before you start, you've got to know what type of generating system you have. While this sounds obvious, it's worth stressing because a wrong connection during a test can easily burn up a perfectly good charging system.

Essentially, there are only two types. Call 'em "A" circuit system and "B" circuit. If you don't know what type you have, don't test the system until you find out.

In the "A" circuit system, field current is picked up by the insulated brush inside the generator, is carried through the field windings to the regulator points and then to *ground in the regulator.*

With the "B" circuit, field current is picked up within the regulator and passes through the regulator voltage control before going to the field in the generator. The field is *grounded in the generator.*

If you don't understand this or can't figure out the schematics on page 880, don't sweat. They're thrown in just to whet the appetite of the theory-minded. All you have to know, actually, is whether you have an "A" or "B" charging system and how it affects the type of connection you must make for the test.

This is an important point. On page 881, you'll find a table listing all American-made cars from 1955 and what type of circuits they have. But keep in mind that it applies only if you still have the *original* generator and regulator in the car. If both have been replaced, the listing will not apply. For example, there could have been a "B" circuit type installed at one time in place of an original "A" type. How do you find out?

You could, of course, disassemble the generator and see to which brush the field coil lead is connected. If it's connected to the insulated brush, you have an "A" circuit; if to the grounded brush, you have a "B" circuit. But that's the tough way.

On some generators, the nomenclature plate will tell you. If it says, "externally grounded" you have an "A" circuit, while "internally grounded" means you have a "B" circuit.

special heavy duty type

In absence of this information, lift the hood and note the generator's make and part number, which will enable a supplier of automotive electrical equipment to tell you what type of circuit you have.

There's a third type of circuit you should keep in mind. It's called a dual-contact system, in which the voltage regulator unit of the regulator has two points instead of one, thus allowing greater control of charge to the battery. It's been in use since 1958 on cars, as those with air-conditioning, which require a heavy-duty generator because of heavy electrical load.

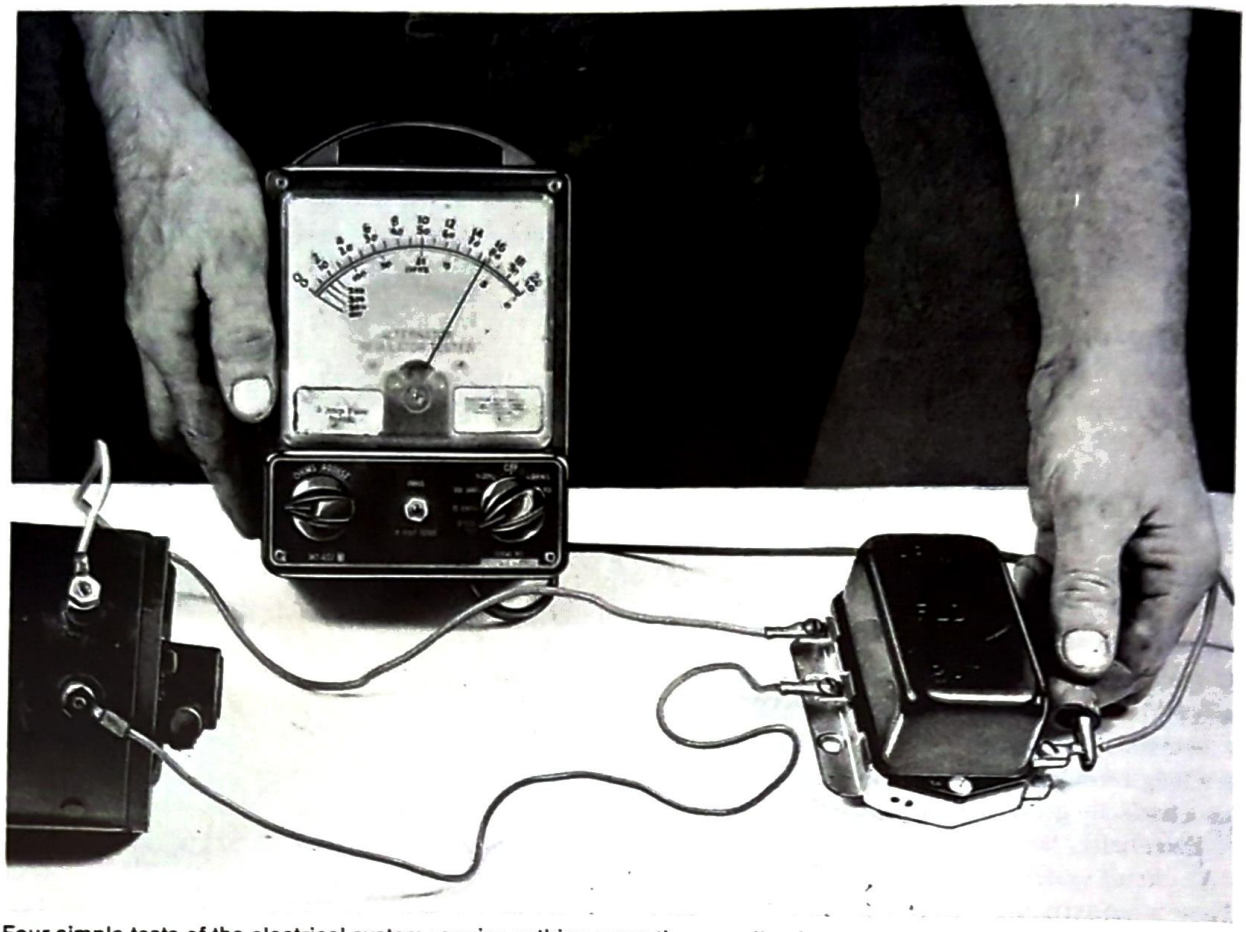
In essence, the dual-contact system is an "A" circuit type, but with an important difference. Later on, you'll find out how to ground out the regulator of both "A" and "B" systems to perform a test. With a dual-contact setup, however, you must not ground out anything without disconnecting the field wire.

If you ground out the system with the field connected, there's a good chance of burning up the regulator.

How can you spot a dual-contact system? Easy enough. All such setups are clearly marked with either a red tag on the generator or stenciled lettering on the regulator. These will say *"do* not ground" or *"disconnect* F before testing generator output" or words to that effect.

Before you so much as lay a hand on a generator or regulator, there are three things to check, to prevent erroneous results from misleading you into replacing a perfectly good unit:

- Fan-belt tension. A loose belt will reduce generator output.
- The battery, as explained before. Obviously, if the battery's run down, it will affect the voltmeter reading when you test the charging system.
- All wiring connections at the battery, generator and regulator, for tightness and cleanliness. One manufacturer of armatures contends that 75 percent of all automotive electrical



Four simple tests of the electrical system require nothing more than a voltmeter. The one shown above incorporates an ohmmeter, but that isn't necessary to check out the generator (left) and the regulator (right). These units can be tested in the car; they were removed for the photo

checking out circuits, continued

troubles are caused by poor electrical connections.

To prepare for testing, let the engine run at fast idle for 15 minutes or so, to make certain the contacts in the regulator close and the regulator's working normally during the warm-up period. This allows the unit to bring itself to operating temperature.

In making the test, observe a safety rule that helps prevent short circuits in the charging system, and protects you from shocks. Disconnect the battery ground cable at the battery. Then, make the hookup. When you're sure everything's connected as it should be, reconnect the ground cable. Furthermore, if you have to disconnect a wire from the generator or regulator, disconnect the battery ground cable first, then the wire.

Reconnect the ground cable to get a reading. As mentioned before, only one meter hookup is needed to check the charging system. Connect one voltmeter lead to the battery terminal of the regulator (identified with the symbol "B" or "BAT"). The other voltmeter lead goes to a *clean* ground, such as a wire-brushed engine bolt or section of generator frame. If your car has a negative ground, the voltmeter's negative lead (black) is the one that connects to ground. If it's positive grounded, the meter's positive lead (red) goes to ground.

Here's how to perform the initial test which tells you whether the charging system is in overall good health:

After making the hookup, observe the meter reading with the engine *shut off*. If high (greater

than about 12.8 v. for a 12-v. system or 6.8 v. for a 6-v. system), the system's overcharging. If the reading is low (less than about 12.4 v. for a 12-v. system or 6 v. for a 6-v. system) the system isn't charging enough. Obviously, then a reading of about 12.5 for a 12-v. system or 6.2 for a 6-v. system gives your charging system a clean bill of health.

troubleshooting an overcharge

Suppose your system shows an overcharge. If the system is a "B" circuit the overcharge cannot be caused by anything but the regulator. That's right. In a "B" circuit the generator and field wire cannot cause an overcharge because the circuit is grounded in the generator. So replace the regulator and you're done.

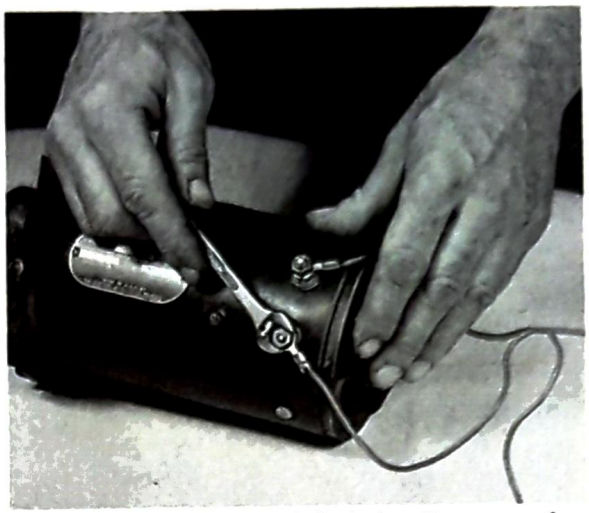
However, for "A" circuits a different procedure is required. Jot down the overcharge reading you just took. Now you must find out whether the overcharge is caused by the regulator, generator or field wire.

To do this, disconnect the field wire *at the regulator*. Start the engine and run it at a speed comparable to about 20 mph. This takes some "feel," but figure on holding the accelerator pedal about one-third down to the floor. (A variation of 5 mph either way won't make enough difference to care about.) Now take another meter reading and see which of the following applies to your situation:

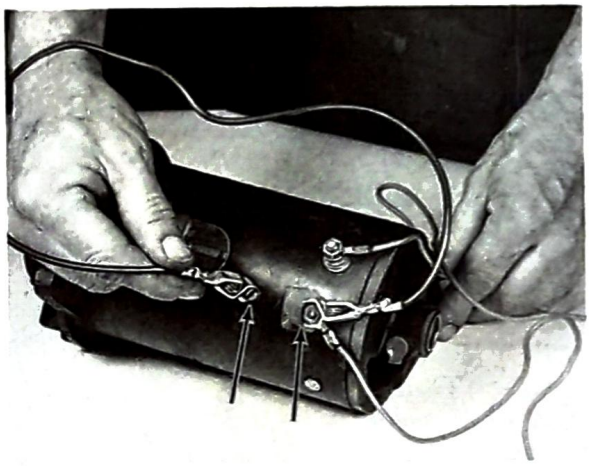
1. If the voltmeter needle returns to its original reading—the one you jotted down earlier—the trouble is in the regulator. The points have probably pitted or burned badly, so replace the unit.

2. If the voltmeter needle reads higher than the original reading, the trouble's in the field wire or generator and you can forget about the regulator. To pin down the exact cause, disconnect the field wire *at the generator* (as shown in the top photo on this page) and again run the car at fast idle. The wire's now disconnected at both generator and regulator, removing the field wire completely from the circuit. If the voltmeter needle now returns to the original reading, the field wire's at fault. Replace it. If the reading remains higher than the original reading you have a ground-out field in the generator. The unit should come off the car, be bench-tested, and repaired or replaced.

Now let's go back to the initial test again. Suppose the meter indicates that the system's *not charging enough*. Leave the meter right where it is. But now you must ground out the regulator

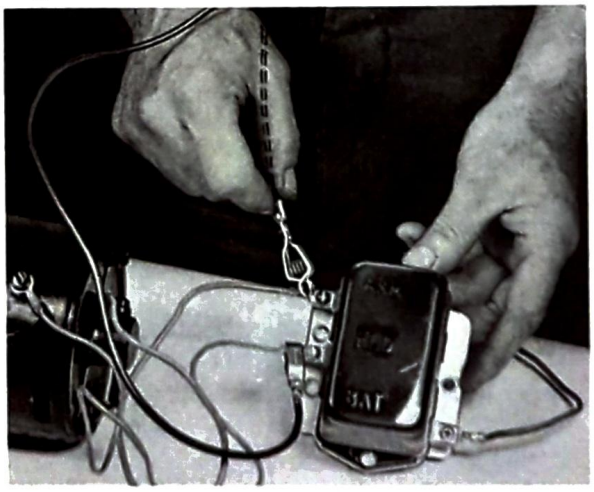


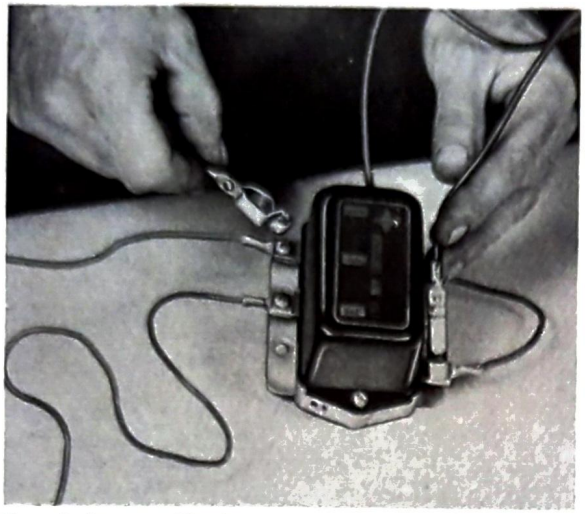
If the regulator has been eliminated as the cause of overcharge, disconnect the field wire at the generator (above) and leave it off the regulator



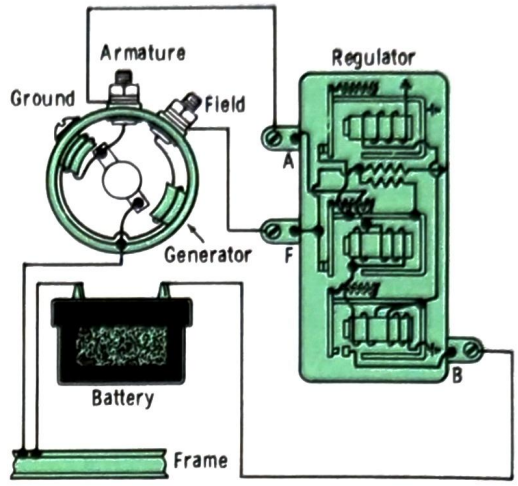
To ground out an "A" circuit voltage regulator, hook a jumper from the generator's field terminal to the ground post of the generator or to the engine itself

To ground out a "B" circuit regulator, hook the jumper from the field terminal of either the regulator or generator to the same unit's armature terminal

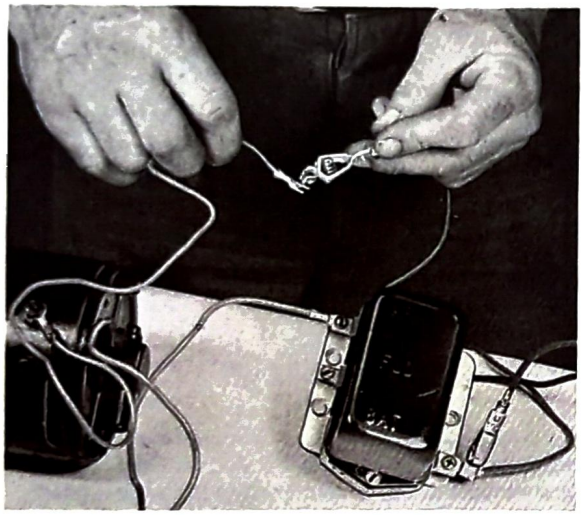




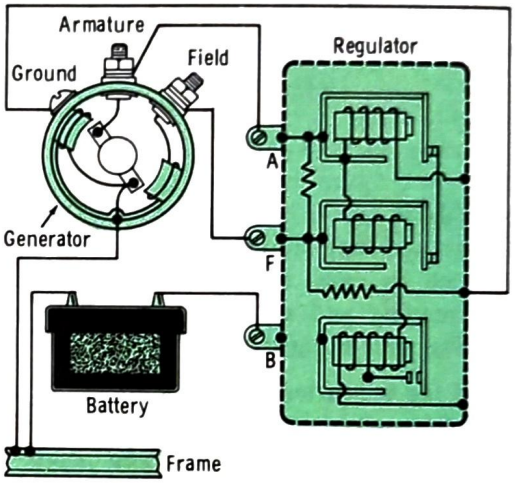
To polarize an "A" circuit regulator, hook the jumper to the regulator battery post and touch the other end to the armature post. Polarize generator similarly



"A" circuit carries current through field windings and regulator points, then to ground within the regulator



To polarize a "B" unit, disconnect the field wire at the regulator, clip the jumper to the battery terminal, and touch the other clip to the field wire terminal



"B" circuit passes field current through the regulator voltage control to the generator, where it is grounded

checking out circuits, continued

—take it out of the circuit so it's not controlling generator output. You do this to determine if your undercharging problem's in the generator or regulator. It's done differently for each of the three different circuits so make absolutely sure you know which type you are working on.

If you have an "A" circuit system, hook a jumper lead from the field terminal of the generator to a clean ground. With "B" circuit systems, the jumper lead goes from the generator field terminal to the generator armature terminal. If you find it difficult to do this, make this "B" circuit connection at the regulator—that is, run the jumper from the regulator's field terminal to its armature terminal (as seen in the bottom photograph on page 879).

With a dual-contact system, disconnect the field wire at the regulator. You can now safely place a jumper wire on the field terminal of the generator and connect it to ground.

By the way, on some generators the field connection's identified by the letter F—on others, by a red tag wrapped around it.

Start the engine and run it at a speed com-

WHICH CHARGING SYSTEM IN YOUR CAR?

USE THIS CHART ONLY FOR OLDER CARS. CARS OF LATER MODEL YEARS THAN THOSE SHOWN BELOW ALL USE ALTERNATORS

CAR AND YEAR	TYPE OF SYSTEM
Buick 1955–62	A
Cadillac 1955–62	A
Chevrolet 1955–62	A
Chrysler (Imperial) 1955–60	A
Comet	See Mercury
Corvair	See Chevrolet
Dart	See Dodge
DeSoto 1955–60	A
Dodge 1955–60	A
Edsel	See Ford
Falcon	See Ford
Ford 1955–64	B
Lancer	
Lincoln (Continental) 1955–59	B
Lincoln (Continental) 1960	A (50-amp generator) or B (40-amp generator)
Lincoln (Continental) 1961–62	B
Mercury 1955–60	B
Mercury 1961	A (40-amp generator) or B (30 or 35 amp generator)
Mercury 1962	B
Oldsmobile (F85, too) 1955–62	A
Plymouth 1955–60	A
Pontiac 1955–62	A
Rambler 1955–59	A
Rambler 1960–61	A (Delco-Remy) or B (Auto-Lite)
Rambler 1962–63	A
Studebaker 1955–62	A
Tempest	See Pontiac
Thunderbird	See Ford
Valiant	See Plymouth

parable to 20 mph. Observe the meter; if it doesn't hit between 15 and 16 v. for a 12-v. system and between 7 and 8 v. for a 6-v. system, the trouble's in the generator.

If the meter does hit the right area, you know the problem's in the regulator, since that unit is now eliminated from the circuit and the generator's acting normally. Replace the regulator.

Undercharging can also result from loose or dirty battery cable connections or armature wire connection at the regulator or generator. However, if you followed the preparatory steps mentioned, this possibility should have been eliminated.

It's a good idea to replace battery cables once a year, or whenever you tune up the electrical system. Cables are not expensive and you eliminate a possibility of their creating resistance in the circuit.

The question now remains as to why you should replace the regulator when it proves to be at fault. After all, can't it be repaired? Here's one good reason:

Modern regulators seldom go out of adjustment. Instead, the likelihood is that the points have become damaged. And they are almost impossible to file properly. The man who files the points is only kidding himself. They won't last long enough to make the job worth the trouble.

If you must replace the generator or regulator, keep in mind that you have to replace an "A" circuit unit with an "A" type and a "B" unit with a "B." One way to be sure is to buy the same part-numbered unit you're replacing.

When a generator has to be stripped down for repair or when replacing a regulator, you should re-polarize the fields to make sure the current's polarity matches the polarity of the electrical system. If the polarity isn't correct, the voltage regulator points will vibrate and arc, causing early failure. And, the generator will provide a current in reverse to that required by the battery. This spells pure trouble.

To polarize an "A" circuit system, all you do is connect a jumper wire to the battery terminal of the regulator. Then, touch the other end of the jumper momentarily to the armature terminal of the regulator (photo, page 880). On some cars, the armature terminal may be referred to as the generator terminal (GEN).

Don't be alarmed at a spark or flash, by the way, as this often happens.

To polarize a "B" unit, first disconnect the field wire at the regulator. Attach one end of a jumper wire to the battery terminal of the regulator. Then simply touch the alligator clip of the jumper to the terminal of the field wire.

That's all there is to it. Simple, wasn't it?

See also: alternators, auto; batteries, auto; headlights, auto; sparkplugs, auto.

Plug-in power control

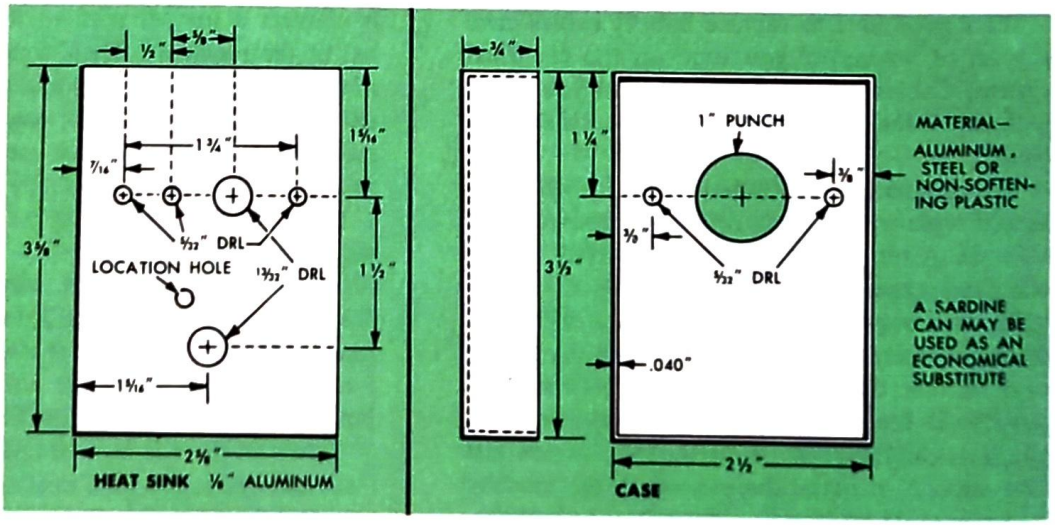
BY DON LANCASTER

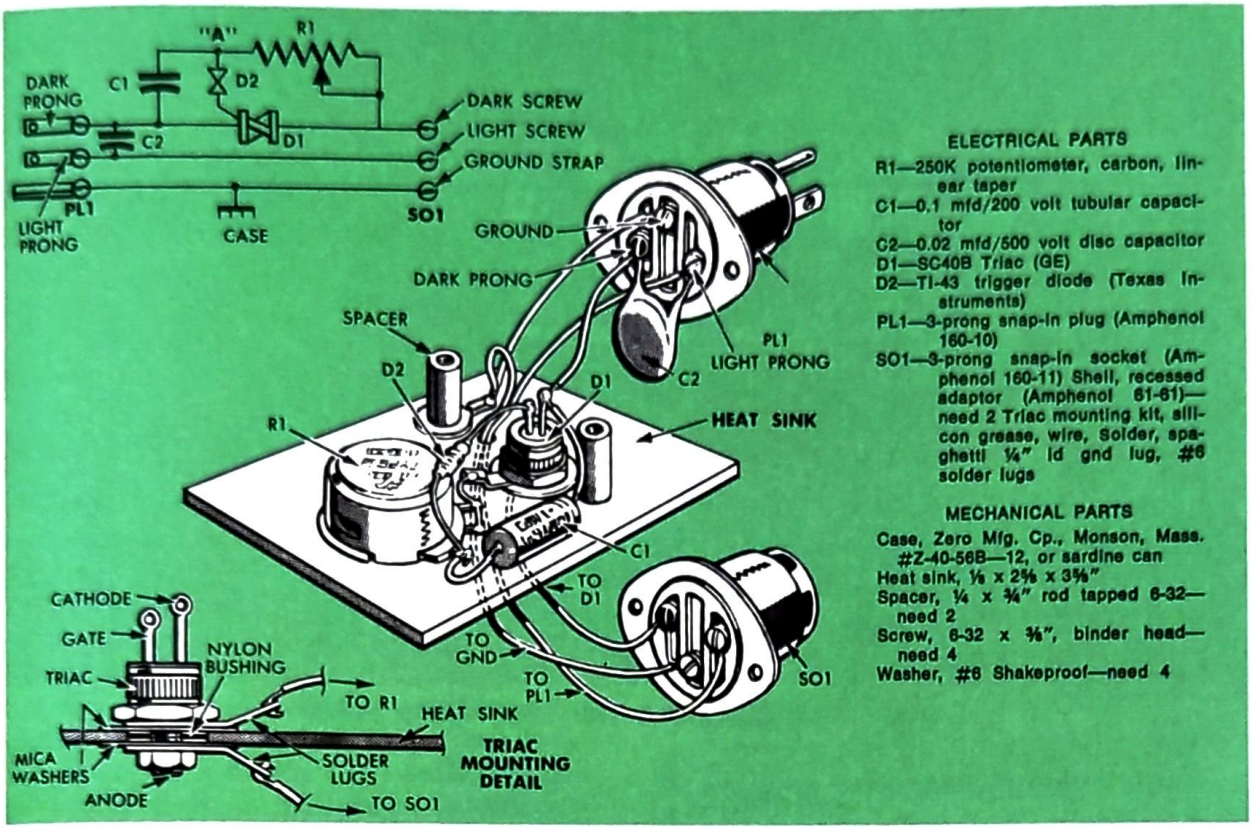
It turns any outlet into a dial speed control for your drill, a heat control for your soldering gun, or a dimmer for any lamp

THERE'S A DECIDED ADVANTAGE in being able to suit the speed of your drill or saber saw to the job at hand. This control box is a compact, inexpensive unit you can make yourself. It plugs in directly to any wall outlet, which means that when you're not using it in the shop you can take it anywhere in the house to serve as a light dimmer, a temperature control for an electric heater—or as a speed control for kitchen appliances. It's rated at a full 600 watts of control power and provides a smooth, continuous range from "off" to "on" with a single turn of its knob. The only place it *won't* work are with fluorescent lamps, induction or synchronous motors, or on current other than 110-volt, 50 or 60 cycle a.c.

The key to the gadget's simplicity is a semiconductor device called *Triac;* it's the equivalent of two silicon controlled rectifiers (SCR's) back-to-back in the same can.

There are two ways to control the power





reaching any motor, lamp or heating coil. You can *vary* the voltage (as with a rheostat or volume control) . . . or you can let *full* voltage reach the load in on-off cycles. By varying the ratio of "on" time to "off" time, you can control the load power. When this is done fast enough—say 120 times a second—the power flow is smoothed out by the inertia of a motor or light-bulb filament.

The Triac is nothing more than an electronic switch. Pulse its gate and it turns on; let the voltage across it drop to zero and it turns off. The Triac, unlike SCR's, works in either current direction, and thus makes no distinction between positive and negative cycle halves. This eliminates the diodes and fancy switches commonly used in the bigger SCR controls.

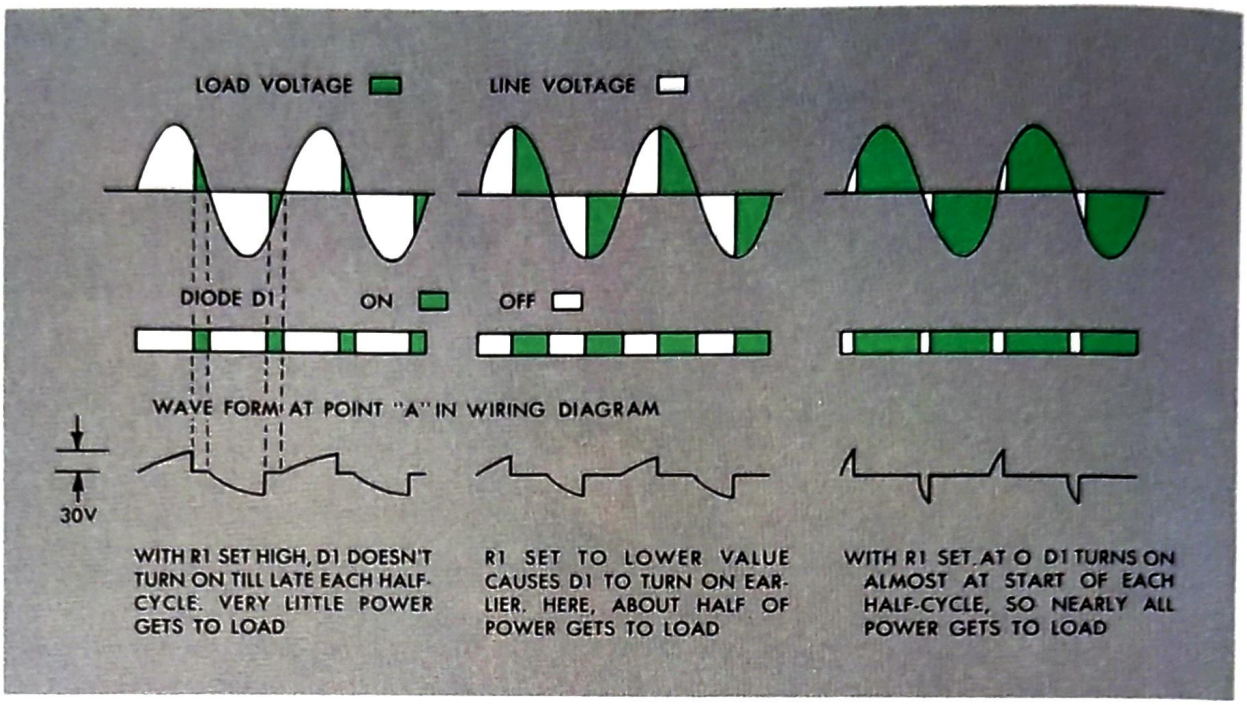
You achieve a *range* of power by controlling the *point* in each half-cycle the Triac is pulsed on. If it's late in the cycle, very little of the available power gets through, and the motor runs slowly or the lamp is dim. If the Triac turns on in the middle of each half-cycle, about half the power gets to the load.

A pulse circuit consisting of a variable resistor (potentiometer—R1 in the sketch), capacitor (C1), and a special avalanche diode (D2), decides when in each half-cycle the Triac (D1) will fire. The diode is rather like a neon lamp; it's off until the voltage across its terminals reaches plus or minus 30 volts, at which point it snaps on for as long as there's any current left in the circuit, feeding this current to the Triac gate. The second, smaller capacitor (C2) is needed to keep the fast turn-on of the Triac from radiating back through power lines as radio noise.

The deep-drawn aluminum box shown in the photos, and listed under "Mechanical Parts," is rather expensive. If you prefer, you can bend up a box from sheet metal—or even use a sardine can. The three-prong plug is used for power-tool safety, and to provide extra support for the plugged-in box.

When drilling the heat sink, note that the smaller of the two potentiometer holes is for the anti-rotation key; its location will vary for different brands. You can substitute copper for the heat sink, as long as it's at least ⅛ in. thick—but not steel or other material. If you're using a sardine can for the box, make the sink slightly larger than the can.

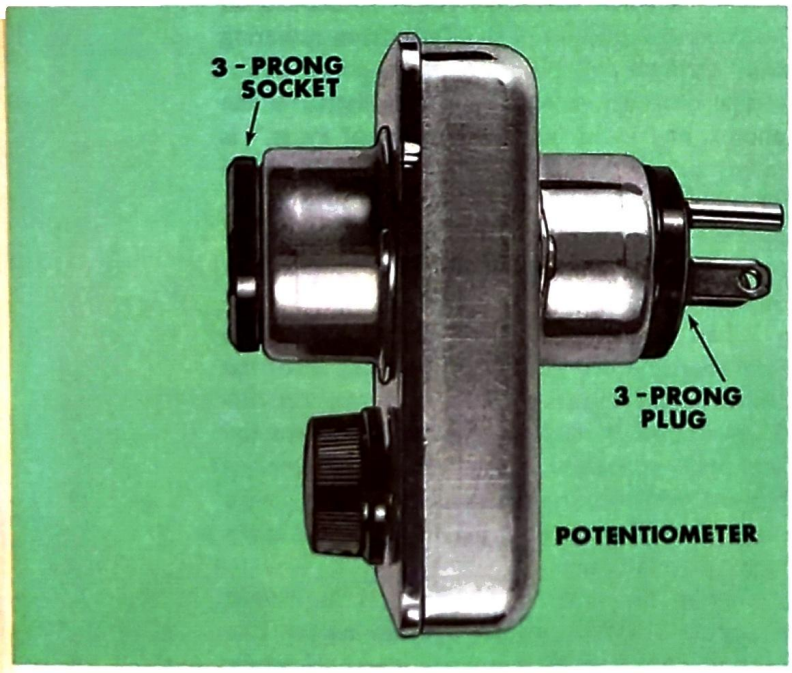
Shorten the stud on the Triac ⅛ in. before mounting it with an insulated mounting kit. Use silicone grease on all mounting parts to insure


LOAD VOLTAGE
LINE VOLTAGE
DIODE D1
ON
OFF
WAVE FORM AT POINT "A" IN WIRING DIAGRAM
30V
WITH R1 SET HIGH, D1 DOESN'T TURN ON TILL LATE EACH HALF-CYCLE. VERY LITTLE POWER GETS TO LOAD
R1 SET TO LOWER VALUE CAUSES D1 TO TURN ON EARLIER. HERE, ABOUT HALF OF POWER GETS TO LOAD
WITH R1 SET AT O D1 TURNS ON ALMOST AT START OF EACH HALF-CYCLE, SO NEARLY ALL POWER GETS TO LOAD

HOW TRIAC CONTROLS THE ELECTRICAL FLOW

speed control, continued

The assembled unit has an extra ground prong for a grounded wall outlet. What looks like the cover is actually a heat sink that gets hot under full load, a normal occurrence



low thermal resistance. Add a second large solder lug to the one provided in the kit, giving a lug on both sides of the sink. Double-check the mounting—with an ohmmeter, if you have one—to make sure there's no electrical connection between Triac and sink.

Use spaghetti on all leads and avoid excessive heat when soldering to the Triac or the diode. Watch the clearance between shells, socket, plug and Triac. If you're careful, everything should fit with safe clearances between terminals. You might want to add a bit of insulation (fish paper, varnished cambric, fiberglass) between Triac and socket. No. 16 stranded wire is best for all leads. The ground wires are connected to the heat sink by means of a solder lug under one of the spacers. The disc capacitor (C2) is added to the plug when the leads are soldered on.

When assembly is complete, test the operation with a 25-watt bulb. (Since the *minimum* load this control will operate is around 10 watts, a neon test light won't do.) The dial should smoothly control the brightness. A small jump from completely off to just-barely-on is normal, followed by smooth control from a pale orange glow to full brightness.

See also: power take-offs; power-tool storage; workshops.

Basics of home wiring

BY EDWARD L. HILTS

If your home is more than five years old, the wiring in it may be obsolete. Here are some ways to find out if it is, and some solid information on how to rewire your house if needed

YOU CAN MAINTAIN the electrical wiring in your home, upgrade it when needed, or even install new wiring when you build an addition. There is nothing mysterious or difficult about electricity *if you take time to learn what it's all about*. If you are careless, electricity can be the deadliest hazard in your home.

Experts say that 90 percent of our homes are inadequately wired, including many homes built in recent years. This is because every year we put more electrical appliances to work in our homes. The use of electricity has tripled in the past 20 years.

If your wiring is inadequate, you will see some warning signals. Fuses will blow frequently. Lights will dim or flicker. The television picture will wobble or shrink. The toaster and iron will take longer to heat up.

These signals should not be ignored. With inadequate wiring, you not only will get poor service from your appliances, but you run a serious risk of fire.

Your electric company generates power and distributes it through a series of sub-stations. Each station steps down the original voltage until it reaches a pole transformer near your home at 2400 volts. From this transformer, it is supplied to you and your neighbors as either 120 or 240-volt service.

In the past we heard the phrase "110 volts," which for years was the voltage service to homes. However, most power companies now have stepped up service. Only a very few still distribute 110/220 volts; some distribute 115/230 volts; the majority provide 120/240-volt service.

All homes should have 240-volt service, and all new homes today are wired for it. If you don't have 240-volt service now, check with your power company. They will install it, often bearing the cost of bringing the new service to your service box.

To determine the type of service you have, check the wires from the transformer to your home. If there are three wires, you have 240-volt service. If there are two, you have 120.

To understand electrical circuitry, you need to know three words: *volts, watts,* and *amperes.*

BE SAFE. FOLLOW THESE PRECAUTIONS WHEN DOING ELECTRICAL WORK AROUND YOUR HOME:

1. Never work on an electrical circuit, an outlet or a switch unless you first disconnect the circuit by removing its fuse or opening its circuit breaker.
2. Never remove a fuse from the service box while standing on a damp floor. Stand on a dry wooden chair or stool or wear rubbers.
3. Never touch the metal service box with one hand while removing fuse with the other. For safety's sake, always keep one hand behind your back when removing a fuse.

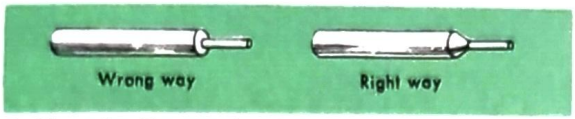
ELECTRICIAN'S VOCABULARY

Volt	Unit used as measure of electrical pressure, like pounds of pressure in a water system.
Ampere	Unit used as measure of electrical rate of flow, like gallons per minute in a water system.
Watt	Unit which shows current drain, combining both voltage and amperage. *Amperes* multiplied by *volts* equal watts.
Horsepower	One HP equals 746 watts.
Circuit	Two or more wires through which electricity flows out from a source to one or more outlets and then returns.
Switch	Device for breaking the flow of current.
Outlet	Device that permits the tapping off of electricity at convenient locations.
Receptacle	Outlet into which electrical cords can be plugged.
Fuse	Safety device which breaks flow of electricity whenever a circuit is overloaded.
Circuit breaker	Performs same function as a fuse, but needs only to be reset, not replaced.
Hot Wires	Power-carrying wires, usually black or red, as distinguished from ground or neutral wires, always white.

WIRE SIZES FOR HOME WIRING

Copper wire sizes are indicated by number. No. 14 is most common in wiring of household lighting circuits. No. 12 is used for appliance circuits. Added margin of safety is obtained by using No. 12 for all circuits. Note that the larger the diameter of the wire, the smaller the number.

Wire Number	Diameter	Ampacity
14	.0641	15
12	.0808	20
10	.1019	30
8	.1285	45



Cutting wire. Remove insulation by cutting at a slant, as in sharpening a pencil. Expose ½ in. of copper conductor. Remove all parts of insulation but not the tin coating which helps in soldering

Solderless connectors. Soldering joints isn't necessary with solderless connectors, which are made of an insulating material so wires need not be taped. Just screw the connector over the wires as shown

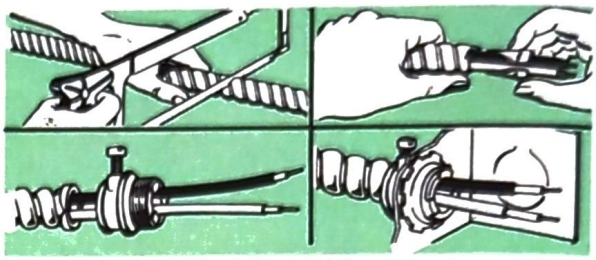
Plastic-sheathed cable—indoor. Used for all types of wire runs indoors, this cable is flat in shape, with a tough, flexible outer jacket. It is easy to pull and strip, particularly where you have to "snake" wire through walls. It has solid-copper conductors

Plastic-sheathed cable—dual-purpose. This cable is made to be used indoors or outdoors and underground. It requires no conduit, is flat in shape. Made to resist moisture, acid and corrosion, it can be run through masonry or between studding

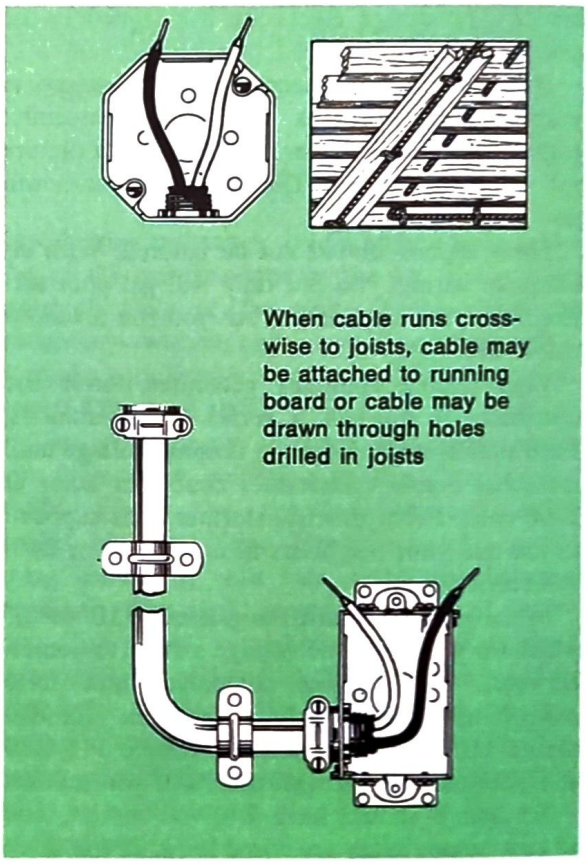
Flexible armored cable. Used for either exposed runs on wall and ceiling surfaces, or for concealed runs in hollow spaces of walls, floors and ceilings. Recommended for use only in dry locations, but it may be embedded in wall or ceiling plaster if not excessively damp. It is not for use in damp indoor locations, outdoors or underground. Must be used with steel switch and junction boxes

drawings courtesy Sears, Roebuck and Co.

Rigid thin-wall conduit. This is the most expensive and most generally accepted type of wiring because it gives greater protection to the wires. It grounds the entire system for added safety. It is required by the electrical code in many cities and towns. Use indoors or out, in damp or dry locations, in masonry (except cinder block). Usually used only in new work



To install armored cable: hold the saw at an angle. Cut through one section of armor, then twist to break. Allow 8 in. of wire for connections in box. Removal of armor exposes paper around wires. Insert bushing between paper and wires. Never forget to insert bushings. Remove paper, slip the connector with the locknut removed over the wires and armor. Be sure the fiber bushing is touching the front of the connector, then tighten the screw. Now wires with connector fastened are inserted through the knockout of the box. Screw the locknut to the connector and draw up tightly for a good ground



When cable runs crosswise to joists, cable may be attached to running board or cable may be drawn through holes drilled in joists

Voltage is the pressure at which electricity is delivered and is similar to the pressure at which water is pumped through a water system. Amperes measure the volume of electricity, and may be likened to the rate of flow (gallons per minute) of water in a pipe. Watts are total electrical energy, figured by multiplying volts by amperes. Thus a 15-ampere circuit at 120 volts means the

circuit has 1800 watts of electrical energy.

Think of the electricity coming from the transformer as a river. In your service box, this river is divided into a number of small streams (individual circuits). Each time you plug in an appliance, you use a part of the water from one of these streams, and you can use no more water than is in the stream at one time.

At the head of each stream, where it is divided from the main river, is a dam (fuse) by which you can stop the flow of water. Just ahead of these small dams is a larger dam (main fuse) which can stop the flow of all water at one time.

In analyzing the wiring in your home, you are attempting to make sure you have enough streams to supply water to all the appliances you use, and to see that the streams are big enough for the job.

This description is oversimplified, but helps in visualizing how electrical circuits work.

about wire sizes

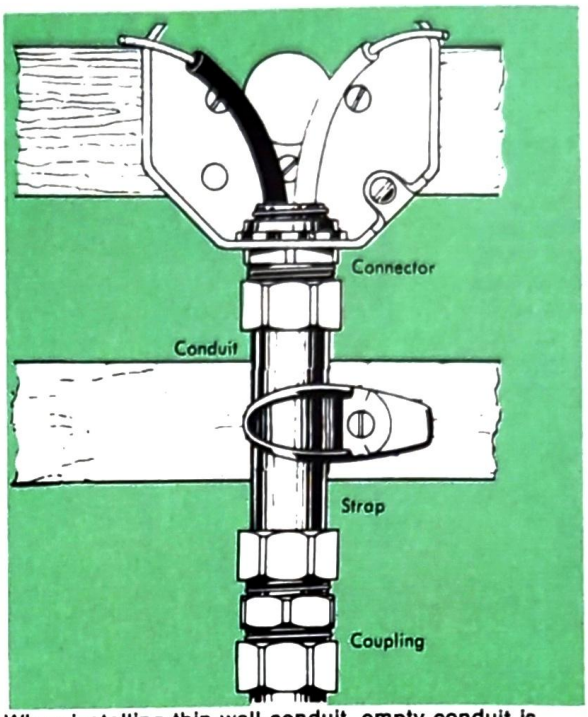
Different sizes of electrical wires carry different amounts of electricity. Each size is designated by a number, and the smaller the number, the larger the wire. Generally, most lighting circuits are wired with No. 14 wire. Most appliance circuits are wired with No. 12 wire.

Wire offers resistance to the electricity passing through it. The larger the diameter of the wire, the less the resistance. Resistance creates heat, and the more resistance, the greater the heat. When you draw too much current through a small wire by plugging in too many appliances, you generate considerable heat—enough, in fact, to create a fire hazard.

While the National Electrical Code (the regulations that set national safety standards for electricity) permits the use of No. 14 wire, some local codes demand that No. 12 be the smallest used. The additional capacity of No. 12 is an extra margin of safety. When you install wiring in your home, it is recommended that you use No. 12, even though it is more expensive.

The color of wires is important. Black and colored wires (usually red) are "hot" wires. They carry current. White wires are neutral or ground wires. The present wiring in your home follows this color pattern, and when you install new wires, you should follow it also.

The National Electrical Code has a formula for determining how many circuits are needed in a home. First, find the square footage of your home, using the outside dimensions of the foundation. Include the area of each floor in use, and also the areas like the basement and attic which may not be in use now but might at some time in the future.



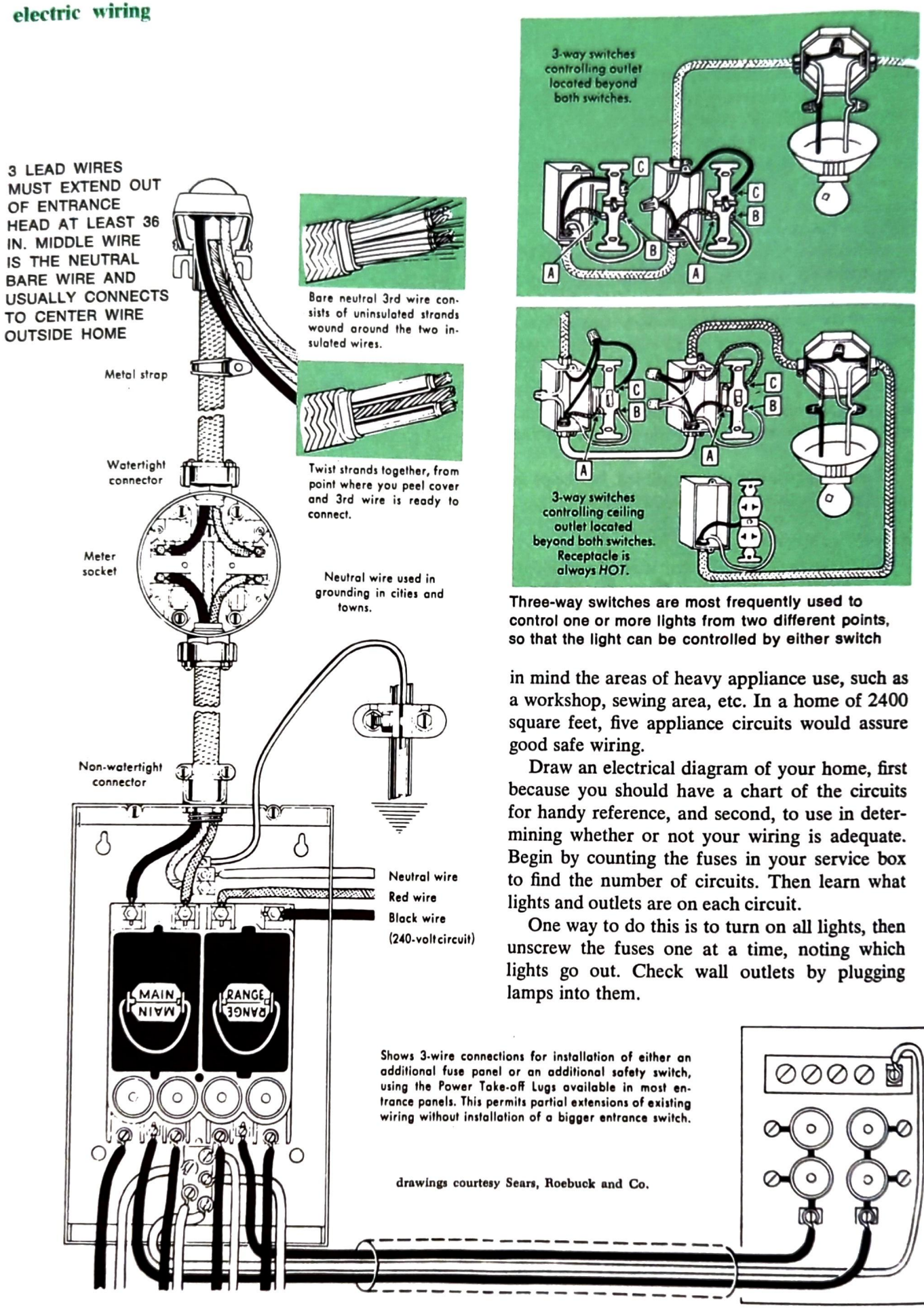
When installing thin-wall conduit, empty conduit is mounted in place before insulated wires are inserted. Use a conduit bender to make all bends, and ream cut ends inside and taper with a file. Support conduit with a pipe strap every 6 ft. on exposed runs, every 10 ft. on concealed runs

The code calls for a minimum of 3 watts available for each sq. ft. of space. This means that a 15-amp. circuit delivering 1800 watts can serve 600 sq. ft. If you divide the total square footage of your home by 600, you will find the minimum number of lighting circuits you should have.

Note that this figure is *minimum,* and refers to lighting circuits only. If you are to have ample wiring with some room for growth, divide the square footage by 400 instead of 600. Thus, if your home is 2400 sq. ft., you should have a minimum of four lighting circuits, but six circuits would be much better.

In addition to the lighting circuits, the code also requires that you have at least two appliance circuits, each rated at 20 amps. and wired with No. 12 wire. No lights are included in these circuits, which are intended for small appliance outlets only. The circuits must serve the kitchen, dining room, laundry, family room, and breakfast area, where you use most of your appliances. Both of these circuits must extend to the kitchen.

In determining adequate wiring for your home, a good rule of thumb is to figure an appliance circuit for each 500 sq. ft. You should also keep

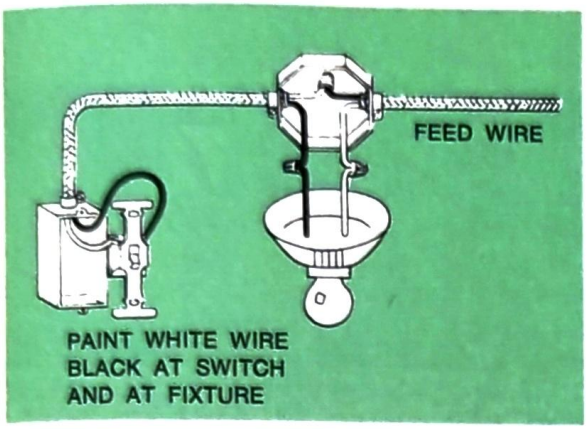

3 LEAD WIRES MUST EXTEND OUT OF ENTRANCE HEAD AT LEAST 36 IN. MIDDLE WIRE IS THE NEUTRAL BARE WIRE AND USUALLY CONNECTS TO CENTER WIRE OUTSIDE HOME
Bare neutral 3rd wire consists of uninsulated strands wound around the two insulated wires.
Metal strap
Twist strands together, from point where you peel cover and 3rd wire is ready to connect.
Watertight connector
Meter socket
Neutral wire used in grounding in cities and towns.
Non-watertight connector
Neutral wire
Red wire
Black wire
(240-volt circuit)
MAIN
RANGE
3-way switches controlling outlet located beyond both switches.
3-way switches controlling ceiling outlet located beyond both switches. Receptacle is always HOT.
A
B
C
Shows 3-wire connections for installation of either an additional fuse panel or an additional safety switch, using the Power Take-off Lugs available in most entrance panels. This permits partial extensions of existing wiring without installation of a bigger entrance switch.
drawings courtesy Sears, Roebuck and Co.

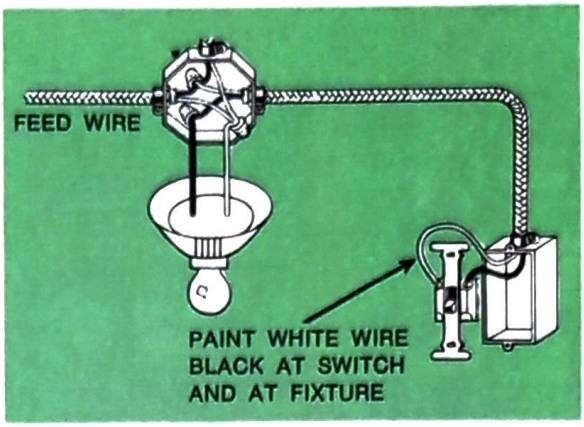
Three-way switches are most frequently used to control one or more lights from two different points, so that the light can be controlled by either switch

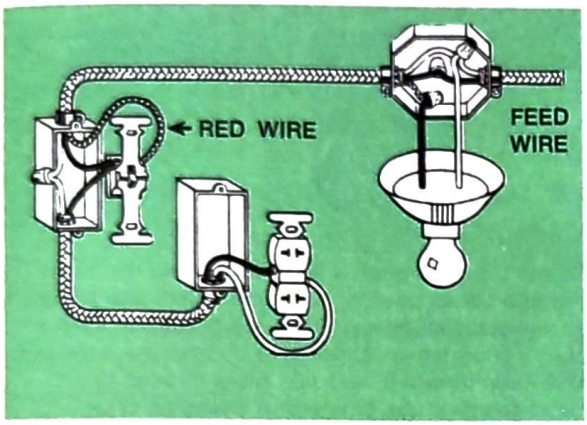
in mind the areas of heavy appliance use, such as a workshop, sewing area, etc. In a home of 2400 square feet, five appliance circuits would assure good safe wiring.

Draw an electrical diagram of your home, first because you should have a chart of the circuits for handy reference, and second, to use in determining whether or not your wiring is adequate. Begin by counting the fuses in your service box to find the number of circuits. Then learn what lights and outlets are on each circuit.

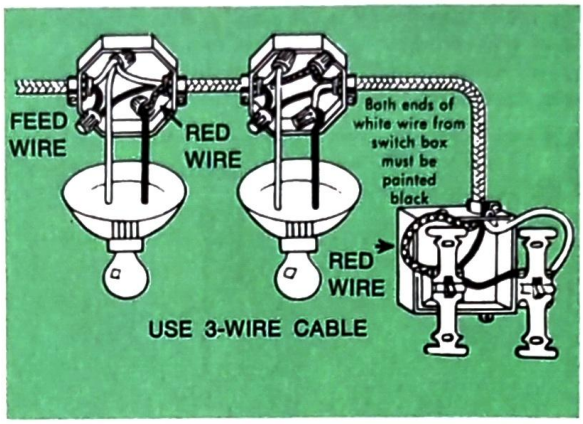
One way to do this is to turn on all lights, then unscrew the fuses one at a time, noting which lights go out. Check wall outlets by plugging lamps into them.



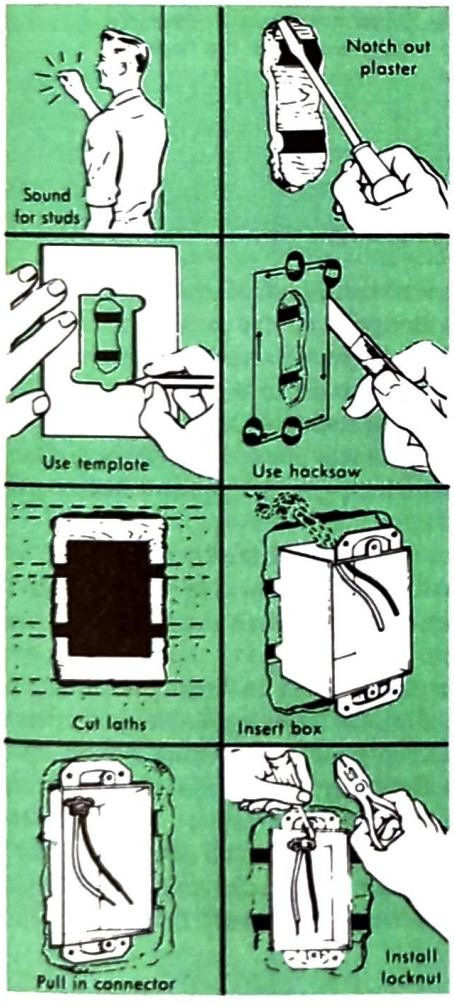




When connecting 3-way switches, follow diagrams carefully. Be sure to connect black, white and red wires as shown. Black wires must be connected to dark-colored terminals C in drawings



When 3-wire cable is required, the white wire from the switch must be painted black at the switch and at the light outlet. This is very important



Switch and outlet boxes in old buildings must be located between the studs. First locate studs, then notch out plaster and use box template. Cut out along template lines and insert box

Now, draw a plan of each floor, locating all lights, outlets and switches. Use colored pencils to join the outlets and lights on each circuit. Finally, number each circuit, and tape the numbers near the corresponding fuses in the service box.

Now survey your chart. Do you have at least as many circuits as are required by the code? As many as you should have for really good wiring? At least two appliance circuits? Individual circuits for such heavy appliances as electric ranges, water heaters, the furnace, clothes dryer, etc.?

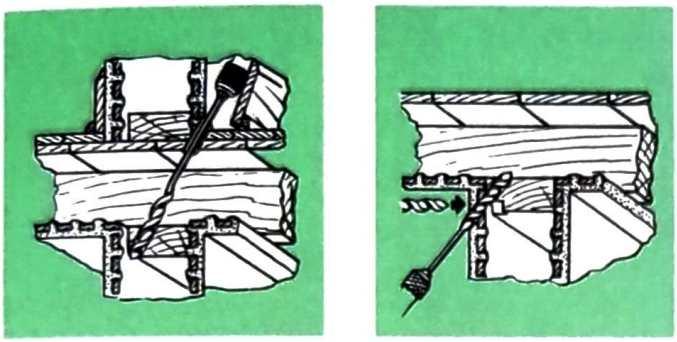
Replan your wiring if necessary. Here are some rules to follow:

1. Plan a wall outlet for every 12 ft. of wall in the house. For convenience, have at least three in each room, more if the room is large.

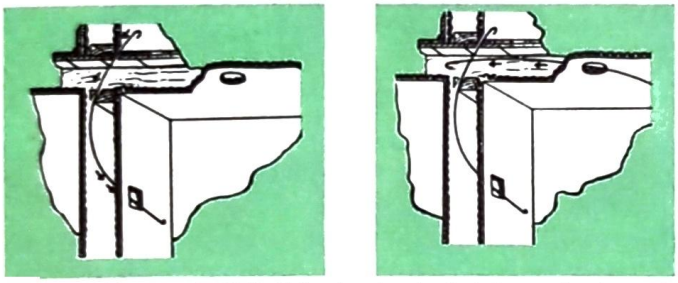
2. One lighting circuit might include two small bedrooms and a bathroom, or a large bedroom and a bathroom.

3. Don't put all the lights on one floor on one circuit. If that fuse blows, you're out of light.

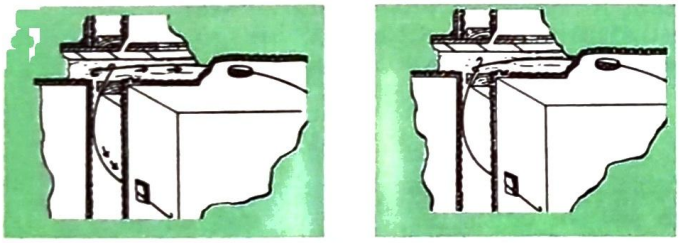
4. Living room and kitchen lights can be on one circuit.



There are a few tricks to "fishing" a wire through floors and ceilings. If you can get into the room above, remove the baseboard and drill a diagonal hole downward. Then drill hole upward from below

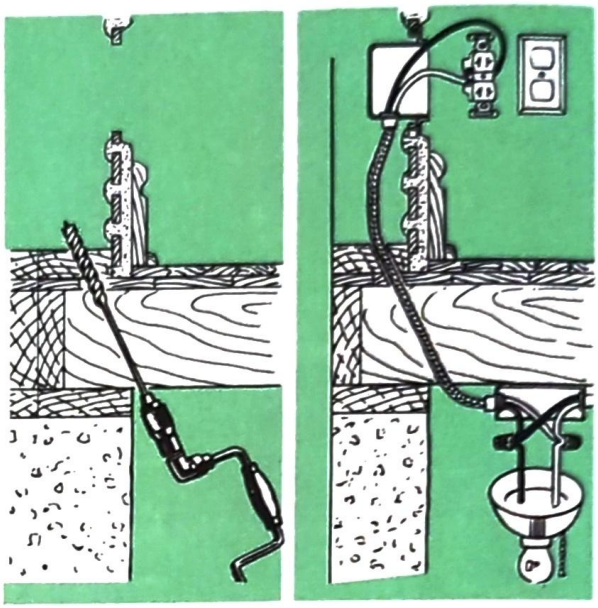


Now push 12-ft. fish wire, hooked at the ends, through the hole on the second floor. Pull one end out at switch outlet. Next push 20-ft. fish wire through a ceiling outlet. Fish until you hook the first wire



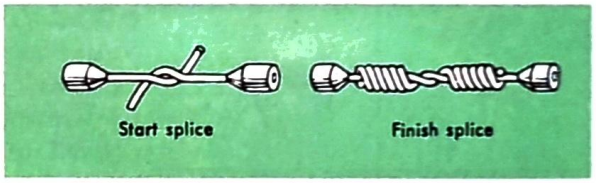
Pull either wire until they are hooked, then pull both until the hooks meet. Finally, pull the shorter wire through the switch outlet. When the hook from the long wire appears, attach cable and pull through

drawings courtesy Sears, Roebuck and Co.



To run a wire through a floor, first select the outlet site and cut an opening through the lath and plaster. Bore a diagonal hole up from the basement. Then push a short length of fish wire up from the basement with wires attached, and pull wires through to outlet opening. Use armored or sheathed cable

To splice wires together, remove 3 in. of insulation from each wire. Cross the wire 1 in. from the insulation and twist 8 turns with the fingers



5. Dining room and hall lights can be on one circuit.

6. One appliance circuit should start in the kitchen and have outlets in the dining room and breakfast or family rooms. Another appliance circuit should serve the kitchen only.

7. Plan separate appliance circuits for the laundry and workshop areas.

8. Plan separate circuits for individual major appliances. Some of these may require 240 v. instead of 120.

Now plan the changes you want to make. Plan new circuits. Check your service box. Does it have empty fuse sockets or unused circuit breakers? If not, purchase an additional service box to be mounted alongside of the present box. There usually are lugs in your present box from which you can wire the service to the new box.

Check the use to which you are putting your present circuits. If you are over-using some, plan to cut them in half, providing two circuits and two fuses.

Now make a diagram of the house as it will be after you have made the wiring changes. Plan your work in easy steps, and make a list of the materials you will need.

There are three kinds of wire permitted by most codes. *Flexible armored cable,* sometimes known as BX, is good for rewiring a home because of its flexibility, since it is easier to run through existing walls. It cannot, however, be used in damp locations, out of doors or underground. And some local codes do not permit it.

Plastic sheathed cable is very flexible and ex-

cellent when you must "snake" wire through existing walls. However, care must be taken when working with it not to damage the plastic covering.

The most acceptable type is *thin-wall rigid conduit*. Most new work is done with conduit, and many cities and towns require it because it does the best job of protecting the wires it carries, and because the entire system is grounded. It is difficult, however, to use in remodeling work.

Before beginning any electrical work, note these precautions:

1. Do not work on any switch or outlet until after you have disconnected the circuit by tripping the circuit breaker or unscrewing the fuse.

2. Use one hand when unscrewing fuses. Do not touch the service box with the other hand. As a safety precaution, hold the other hand behind you.

3. When working at the service box, pull out the main fuse, completely disconnecting the box from the incoming lines.

4. Do not stand on damp flooring when removing fuses. Study the service box. You will see the wires that come in from the transformer—a black, a red, and a white wire. Each of the colored wires carries 120 v. The white wire is neutral.

how wires are connected

The black and the red wires are connected to the main fuses or circuit breakers, while the white wire is connected to a copper bar, which in turn is grounded by being connected to a water pipe. If you pull the main plastic fuse box out, you will find in it two red fuses that look like shotgun shells. When the box is pulled out, all electricity is shut off. When it is pushed back into position, current flows again.

Each of the individual fuses or circuit breakers is connected to the main fuse. If the wiring is visible, you will see that the connection is made with a black wire. A white wire connects each individual fuse to the grounding bar.

You may find several lugs or big screws near the fuses. These are the points at which you attach the wiring when you install another service box. Many service boxes have what appears to be a second main fuse, usually marked "Range." This is the fuse for a 240-volt circuit, and both incoming hot wires are connected to it, while only one of the incoming wires is connected to the other main fuse.

If you have enough empty fuse sockets for your additional circuits, follow this procedure when wiring a circuit to the box:

1. Pull out the main fuse to turn off current.

2. Knock out a hole in the side of the box to receive the new circuit. Select a "knock-out" hole near the fuse to be used.

3. Attach connector to circuit wire (whether conduit, armored cable or plastic cable). Insert connector in hole, thread on locknut and tighten. You should have about 8 in. of wire in box.

4. Strip ends of wire and form a hook on each. Put black wire under the screw at the fuse socket. Put the white wire under a screw on the grounding bar. Tighten screws.

5. Insert main fuse in box. Current is now flowing. Finally, screw in 15-amp. fuse or set circuit breaker.

Refer to the illustrations on these pages for instructions for installing different kinds of wire, for wiring switches, for splicing wires, etc. Take your time as you do electrical wiring. Double check your work, and redo it if it isn't neat. Make each splice, each connection, each outlet or switch installation as clean and professional as possible.

the tools you'll need

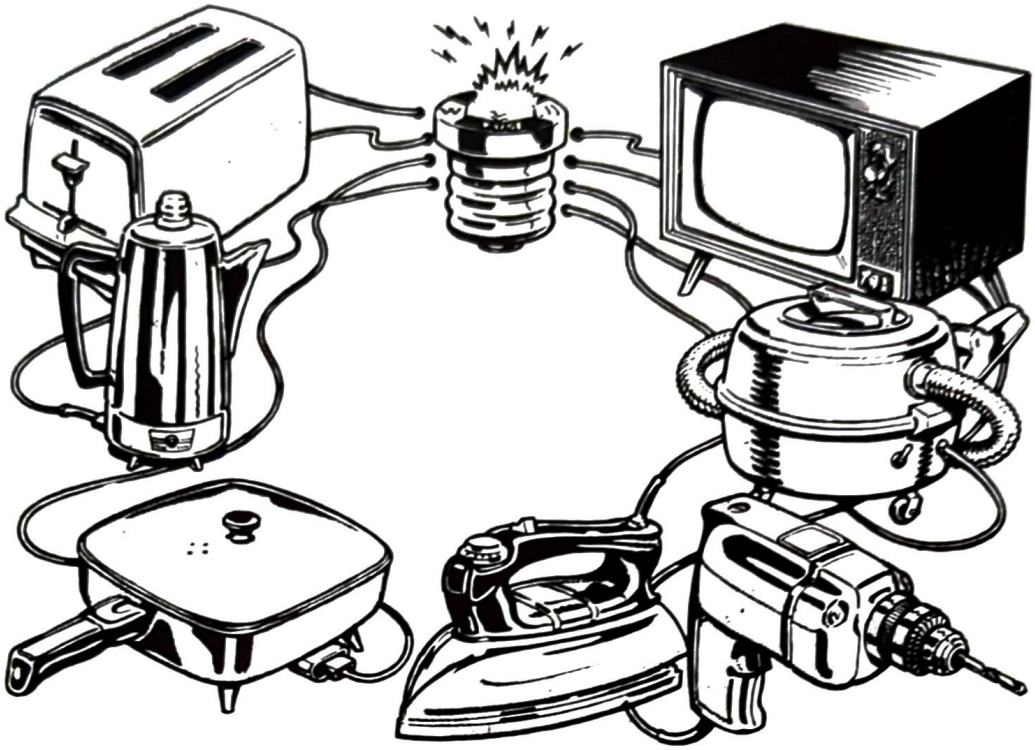
Generally, you will find the following tools useful for rewiring your home: hammer; screwdriver; a long ⅝-in. drill bit; brace; keyhole saw; hacksaw; wire stripper; a lineman's pliers for gripping locknuts; jackknife; chisel; 6-ft. folding rule; fish tape and reel for pulling wire through walls and conduit; conduit bender; conduit cutter.

You have many of these already. Most are not expensive, and you can rent some, such as the conduit bender and the fish tape.

Before undertaking any major rewiring of your home, be sure to check your local codes. Plan your work in accordance with the code. You may need a permit, and you may have to submit to an inspection. Be sure to find out before you start.

If you have complied with the code, and your work passes inspection, you are in good shape. If, however, your home were destroyed by fire and your insurance company determined that you had rewired in a manner that didn't agree with the code, or if you had avoided inspection when it was required, your insurance might be cancelled and the loss not covered.

Passing an inspection is not difficult. The inspector wants to know that you have complied with the code, and that the work was done according to accepted practices. For your own safety, these are things you should do.



Is your wiring overloaded?

BY DONALD W. SEGRAVES

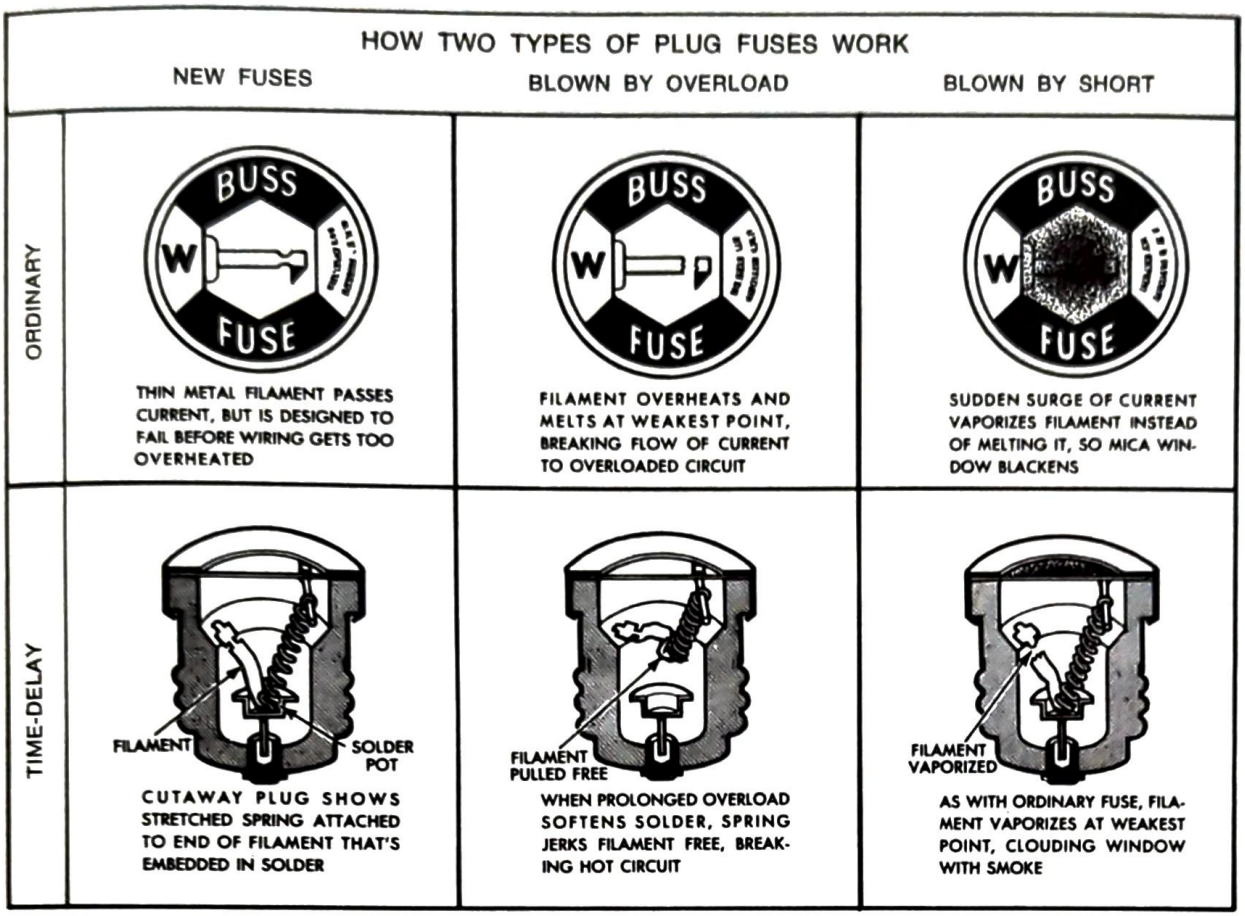
When a fuse blows it's a warning that it's time to wonder if the wiring in your house is safe for today's heavier electrical loads

The tamper-free fuse has smaller base and needs an adapter to fit a standard socket. But once it is in place, you can't put in wrong-sized fuse, you can't put a penny in the socket, or bridge it with wire or foil

A BLOWN FUSE in your home is like a fever in your body. It's a signal that something has gone wrong—not just a nuisance to be ignored.

The most popular way to ignore this signal is to eliminate the warning by putting in a bigger fuse. This *does* succeed in stopping electrical blackouts, but it may also run up your electric bill, cause your motors and appliances to give poor service—even set your house afire.

What you're doing, in effect, is tying down the safety valve so you can pull 30 amps of current through wires designed to carry only 15 or 20. It can't be done efficiently, so each appliance on the overloaded circuit operates at less than full power. Electric motors run slower, struggling to


HOW TWO TYPES OF PLUG FUSES WORK
NEW FUSES
BLOWN BY OVERLOAD
BLOWN BY SHORT
ORDINARY
TIME-DELAY
BUSS
W
FUSE
THIN METAL FILAMENT PASSES CURRENT, BUT IS DESIGNED TO FAIL BEFORE WIRING GETS TOO OVERHEATED
FILAMENT OVERHEATS AND MELTS AT WEAKEST POINT, BREAKING FLOW OF CURRENT TO OVERLOADED CIRCUIT
SUDDEN SURGE OF CURRENT VAPORIZES FILAMENT INSTEAD OF MELTING IT, SO MICA WINDOW BLACKENS
FILAMENT
SOLDER POT
CUTAWAY PLUG SHOWS STRETCHED SPRING ATTACHED TO END OF FILAMENT THAT'S EMBEDDED IN SOLDER
FILAMENT PULLED FREE
WHEN PROLONGED OVERLOAD SOFTENS SOLDER, SPRING JERKS FILAMENT FREE, BREAKING HOT CIRCUIT
FILAMENT VAPORIZED
AS WITH ORDINARY FUSE, FILAMENT VAPORIZES AT WEAKEST POINT, CLOUDING WINDOW WITH SMOKE

carry their loads. Toasters take longer to brown bread, bulbs give less light. Since you pay for electricity by the kilowatt hour, you run up your electric bill when appliances are slow, or when you must use a 150-w. bulb to get the same light normally shed by a 100-w. bulb.

Worst of all, overloading the wiring causes it to heat up. Gradually, the insulation bakes off leaving the hot wires exposed to start fires by direct contact with dust, wood or paint—or by shorting out in a shower of sparks. That's why overloaded circuits are the top cause of fires.

Fortunately, there are safer and more efficient ways to solve blackout problems than using oversize fuses. The first step is to find out what's causing those fuses to blow. You can usually tell whether the cause is an overload or a short just by looking at the blown fuse—as the chart demonstrates. If the mica window is blackened, it means that somewhere on the circuit there's a bare wire touching either another wire or some other metal. This sent a surge of current coursing through the wires, producing a flash of heat that vaporized the filament.

If the window of the blown fuse remains clear, your trouble was overload. The heat buildup, here, was gradual; the fuse filament simply melted at its weakest point.

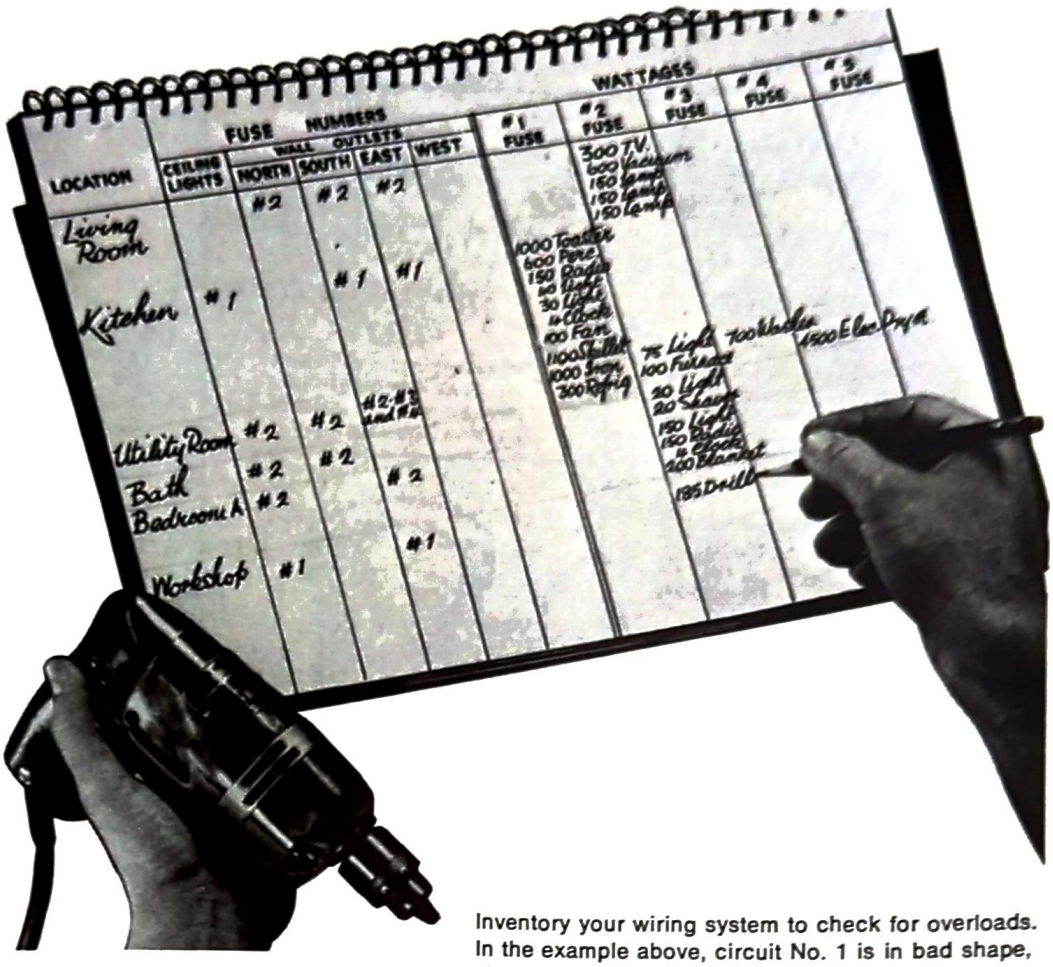
To check for a short, unplug everything served by the circuit that blew the fuse—that is, all lights and appliances that don't work. Also turn off ceiling lights—and appliances wired into that circuit. These devices should have separate fuses and on-off switches located somewhere near the motors. Either turn off these switches or remove the fuses.

When the circuit is completely clear replace the blown fuse with a good one, or push the circuit breaker button back on. If the new fuse blows or the breaker button snaps off again, there's a short in the circuit wiring itself. You'd better call an electrician.

Most likely, though, you'll find the bare wire in a frayed lamp cord, extension cord, or appliance wiring. Check each lamp, switch and appliance one at a time by turning it on. When you reach the faulty one, the new fuse will blow.

If your original inspection of the blown fuse

is your wiring overloaded, continued



Inventory your wiring system to check for overloads. In the example above, circuit No. 1 is in bad shape, since several combinations of kitchen appliances would pull more than the allowable 1800 w. It should be split in two. Circuit No. 2 is probably safe—overload combinations aren't likely unless a heavy workshop load is added. Fuse No. 4 is a 220-amp. circuit

led you to suspect an overload, the same check for a short will provide confirmation: say the new fuse blows only when you plug in the last item on the circuit. Unless it happens to be defective, your problem is an overload. Further checking will tell you if you can cure it.

If that final, fatal appliance is driven by an electric motor, the issue is still in doubt. What you want to know is whether the overload is constant, or whether the fuse blows only when a motor kicks on. An electric motor usually pulls three to five times its normal current to start.

You can cure this type of temporary overload by buying time-delay (dual-element) fuses. A 15-amp time-delay fuse will handle motor-starting currents every bit as well as an ordinary 30-amp type—and the smaller fuse gives you far better protection against prolonged overloads and short circuits. That's why the National Electric Code now specifies time-delay fuses for all home-wiring circuits. The most widely-sold brands are Fusetron and Fustat. They're identical except that Fustats also have a tamper-free feature, as shown in the photo on page 892. The reduced-size base requires an adapter, if you're using these fuses in an old-type socket.

But how do you tell whether your overload is temporary or constant? One way is to replace the blown fuse with a time-delay type of the correct size (either 15 or 20 amp.) and see if *it* blows with everything turned on. If not, your problem's solved. But if it does, you'll either have to split the overloaded wiring into two circuits, shift some appliances to other outlets, or be extra careful how many major appliances you operate off any one circuit at one time.

You can avoid trial and error by making an inventory of your wiring system so you know how big a load is on each circuit. Here's how:

• Go to the main entrance switch and number each fuse or circuit breaker, using small gummed labels, or the diagram often pasted inside the fuse-box door. Make a work sheet like that shown, tailoring it to fit your home. Under "wattages," provide a separate column for each fuse or circuit breaker in actual use.

• Turn on every light in the house and check to see that all bulbs are burning. Then, unscrew fuse No. 1 and go through the entire house, marking a #1 on the work sheet for each light that's out. Do the same for all receptacles, using a small hand lamp to see if they're dead. As you go, note the wattages of all lights and appliances served by this circuit, listing them in the column marked #1 Fuse.

Most appliances have their wattage rating marked on a nameplate attached to the device itself, or to the motor that operates it. Motor-driven appliances may give only a horsepower figure; to convert to wattage, multiply this figure by 746, since 746 watts equal 1 hp. If no rating is given, use the averages for common appliances listed on this page. These should be close enough to permit a proper evaluation of circuit load.

• Replace Fuse No. 1 and repeat as above for each remaining fuse (or circuit breaker). Don't forget to check closets, hallways and appliances that aren't plugged in permanently, such as workshop tools and kitchen gadgets.

• Add up wattages of all lights and appliances served by each circuit. Consider the maximum load likely to be placed on each. If the kitchen circuit has two double-socket wall outlets, for example, list the four highest-rated appliances that might be plugged in simultaneously (for example: toaster, percolator, skillet and waffle iron—a whopping 3800 w.).

Maximum safe load for circuits wired with 14-ga. wire is 1800 w. These circuits should carry 15-amp fuses only. Circuits wired with 12-ga. wire can carry up to 2400 w., using 20-amp fuses (30-amp fuses are *not* recommended for any home lighting or general-use circuit). If you don't know what size wire you have, pick up short pieces of each size at your hardware store and compare them with the exposed wires visible when you take the cover off your fuse box. No. 14 wire is about the size of the lead in an ordinary wooden pencil; No. 12 is slightly larger.

After all this checking, you should be able to decide intelligently whether that blown fuse is only an easily-remedied annoyance, or the sign of a serious defect that calls for professional cure.

AVERAGE WATTAGES

110-120-VOLT APPLIANCES

BASEMENT	
Dehumidifier	160 w*
Dryer Clothes, Gas	350 w*
Freezer, Home	350 w*
Furnace, Coal Stoker	400 w*
Furnace, Gas	100 w*
Furnace, Oil	800 w*
Incinerator	600 w
Ironer-Mangle	1650 w*
Mower, Lawn	300 w*
Pumps (Well or Sump)	300 w*
Washer, Auto Clothes	700 w*

WORKSHOP	
Drill, ¼ in., ⅜ in., or ½ in.	100, 185, or 375 w*
Grinder, Light or Heavy Duty	185 or 375 w*
Iron, Soldering	150 w
Lathe, Wood or Metal, ⅓ hp	250 w*
Sander, Portable, 1 hp	746 w*
Saw, Band, 12 in., ⅓ hp	250 w*
Saw, Bench, 8 or 10 in.	375 or 560 w*
Saw, Circular, Portable	1120-1500 w*
Saw, Jig, 18 in., ⅓ hp	250 w*
Saw, Radial Arm, 9 or 10 in.	1300 or 1500 w*
Saw, Saber, ⅛ or ⅓ hp	100 or 250 w*

LIVING ROOM	
Air Conditioner, ⅓ or ¾ ton	750 or 1400 w*
Phonograph	75 w*
Radio, Console Type	150 w
TV Set	300 w
Vacuum Cleaner	600 w*

KITCHEN	
Baker, Portable	900 w
Blender, Food	250 w*
Casserole, 6 Quart	330 w
Corn Popper	500 w
Dishwasher (Heated)	1250 w*
Dishwasher (Unheated)	400 w*
Disposal, Waste Food	500 w*
Egg Cooker	500 w
Fryer, Deep-Fat	1350 w
Hot Plate (Per Unit)	700 w
Iron, Hand (Dry or Steam)	1000 w
Mixer, Food	150 w*
Pan, Sauce	1000 w
Polisher, Floor	350 w*
Percolator, 6-Cup	600 w
Refrigerator (12 Cu. Ft.)	300 w*
Roaster-Rotisserie	1400 w*
Skillet, Frying	1100 w
Toaster	1000 w
Waffle Iron	1100 w

BEDROOM & BATH	
Blanket	200 w
Bottle Warmer	400 w
Dryer, Hair	275 w*
Fan, Window (Large)	500 w*
Heater, Portable, Reflec.	1200 w
Heater, Wall (Built-in)	1250 w
Lamp, Heat, Infra-Red	250 w
Lamp, Sun, Ultra-Violet	400 w
Pad, Heating	60 w
Shaver	20 w*

220-VOLT APPLIANCES

(NEED SEPARATE CIRCUITS AND FUSING)

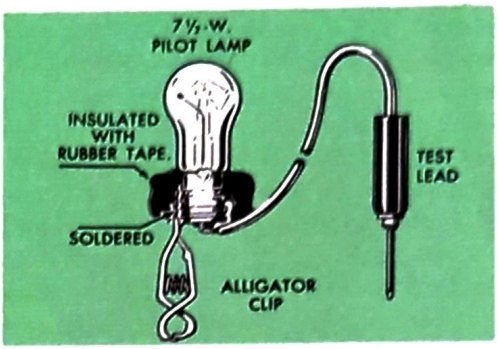
Air Conditioner, 1-Ton	1600 w*
Dryer, Clothes	4500 w*
Pump, Water, Deep Well	1250 w*
Range, Cooking	8000-16000 w
Water Heater, 50-Gal.	2000 w

* MOTOR-DRIVEN APPLIANCE

Ideas for amateur electricians

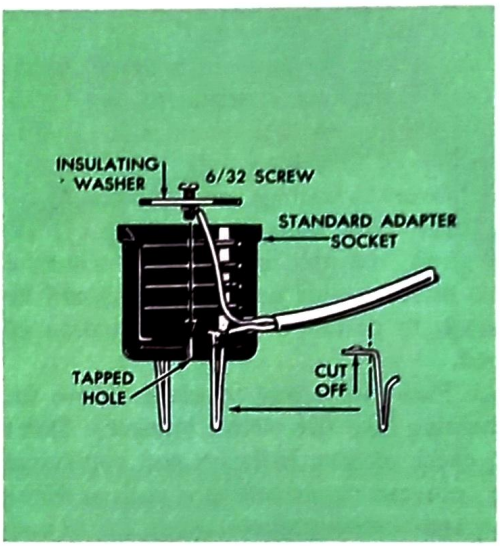
Circuit tester. This circuit tester lets you spot blown fuses in your fuse box. It's made by soldering a small alligator clip to the side of a 7½-w. Christmas tree or pilot lamp. A single test lead is then soldered to the bottom of the bulb, and the base is wrapped with tape.

To use it, clip the tester to the edge of the metal fuse box and touch the fuse terminals with the test lead. When the lamp doesn't glow, you've located the blown fuse.



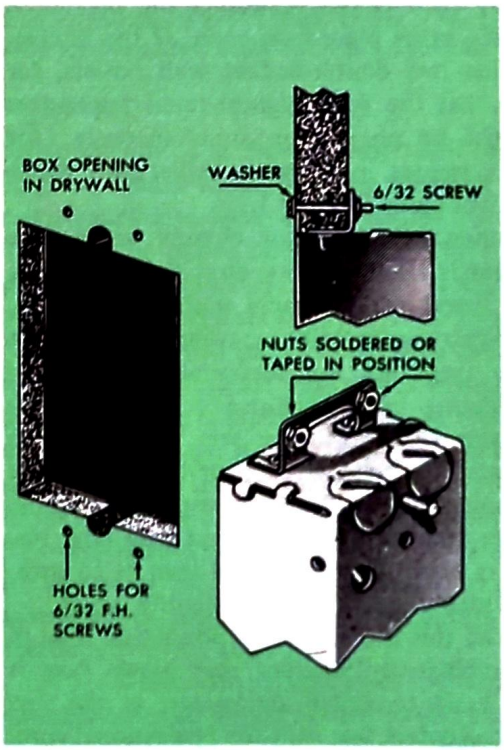
Continuity tester. This tester can be made from a standard adapter socket. Two holes are made in the socket, one in the side for the test leads, and a tapped one in the bottom for a 6-32 screw. The prong which normally makes contact with the bulb is forced out of the socket, cut off at the point indicated and replaced. Then one test lead is soldered to the cut-off prong and the other lead to the 6-32 screw.

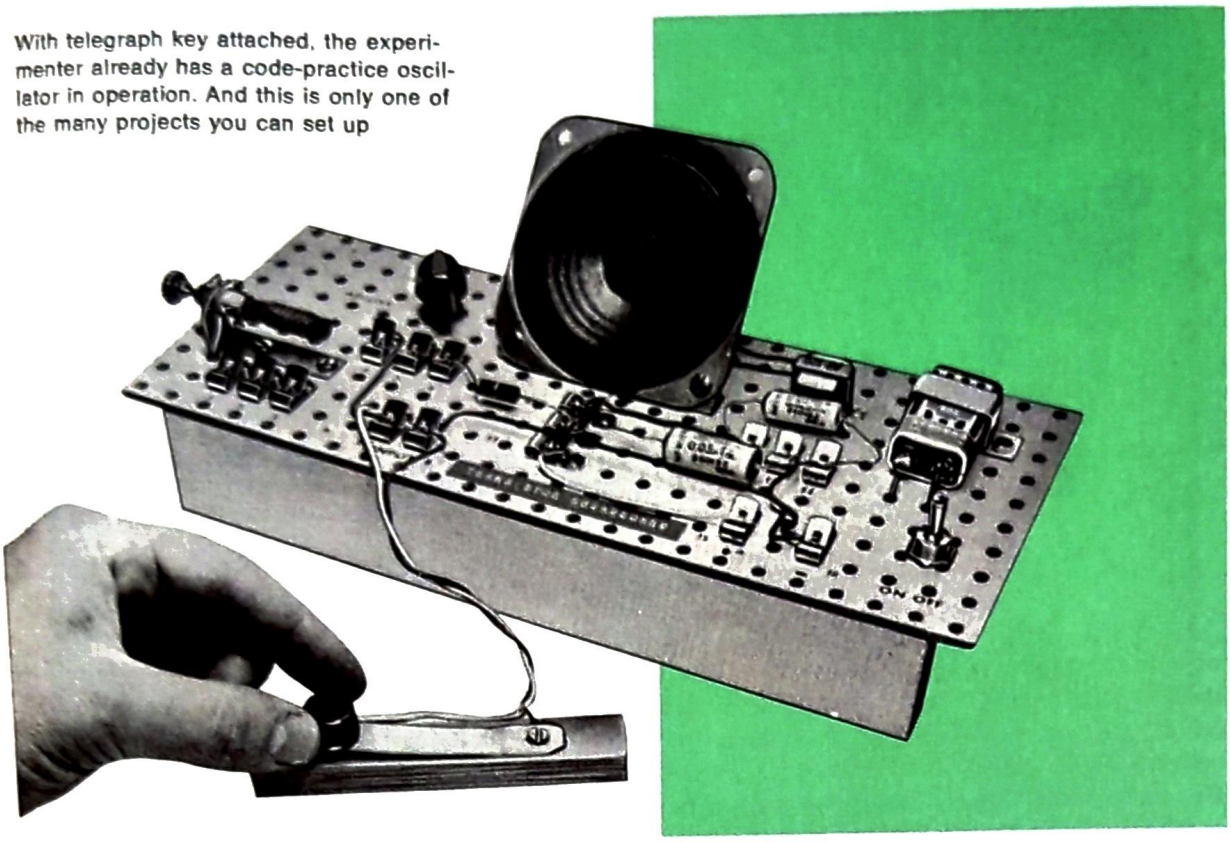
To use the tester, you screw a bulb in the socket and plug the socket into a wall outlet. If the bulb doesn't glow with both probes applied to the appliance plug, there is a break in the circuit. If the test light glows with one probe applied to a prong of the plug and the other probe touched to the appliance, there's a short.



Mounting gem boxes. You can easily mount gem boxes in walls which have wood lath, since you can drive the screws right into the wood.

But it's a different story in plasterboard walls. Here sheet-metal brackets called Holdits, must be used to anchor the boxes. However there's another way to do it which actually anchors the box more securely. First place the box (open side against the wall) and trace around it, including the half-round ears at top and bottom. Next, cut the opening, insert the box, and mark the holes in the L-brackets. Remove the box and drill the holes through the plasterboard. Now either solder or tape the nuts of four 6-32 flat-head screws to the back of the L-brackets, centering them over the holes. With this done, attach your BX to the box, slip it and the box back into the hole, being careful not to let it drop, and pull the box forward until the L-brackets bear against the rear side of the plasterboard. Now, turn the screws until they catch hold and draw them up tight.





With telegraph key attached, the experimenter already has a code-practice oscillator in operation. And this is only one of the many projects you can set up

Eight experiments with a transistor breadboard

BY LEN BUCKWALTER

Need a burglar alarm, rain detector, metronome? Build them tonight—on the kitchen table

A TRANSISTOR BREADBOARD is a big bargain for anyone who likes to tinker on a tabletop. With about six dollars in parts you can assemble a surprising number of projects quickly and without any soldering.

The board described here builds up circuits ranging from light and water detectors to a musical instrument, code practice oscillator, metronome and an alarm. It can even test transistors, diodes or the cord on the family toaster. The board is shock-free and requires no special electronic skills to build and operate.

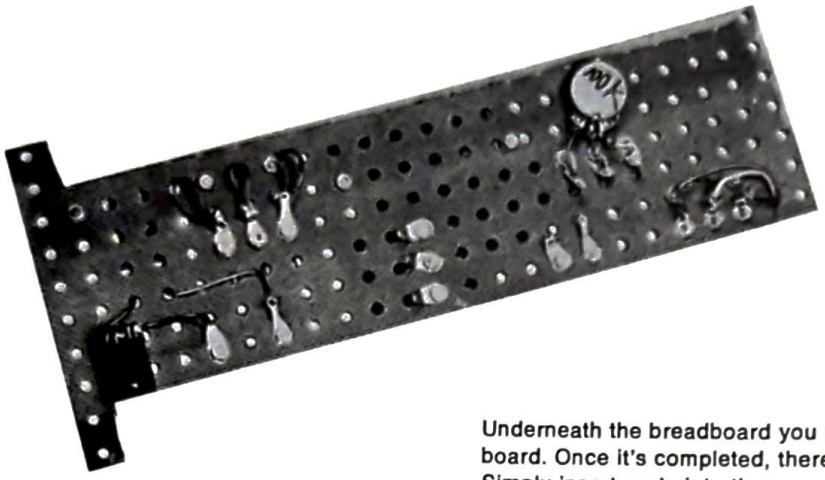
A piece of standard perforated hardboard is the basic chassis. Sixteen Fahnestock clips are mounted and numbered (see head photo). After the clips are fastened down, solder lugs are placed under the mounting nuts for the leads of the major components.

The battery is held down by a metal strip bent into a U-shape which is fastened to the board. Check polarity to be sure it's correct. Correct transistor mounting is also important. Double check the transistor against the basic diagram.

Once assembled, check the board by flipping the power switch on and touching a short piece of wire across clips 7 and 8. If you hear a tone from the speaker, everything is wired correctly.

Here are the eight projects, experiments and demonstrations that you can perform with the transistor breadboard:

1. *Water Detector.* Take two pieces of hookup



Underneath the breadboard you can see the wiring of the basic board. Once it's completed, there is no more soldering to do. Simply insert parts into the proper clip to set up experiments

electronic experiments, continued

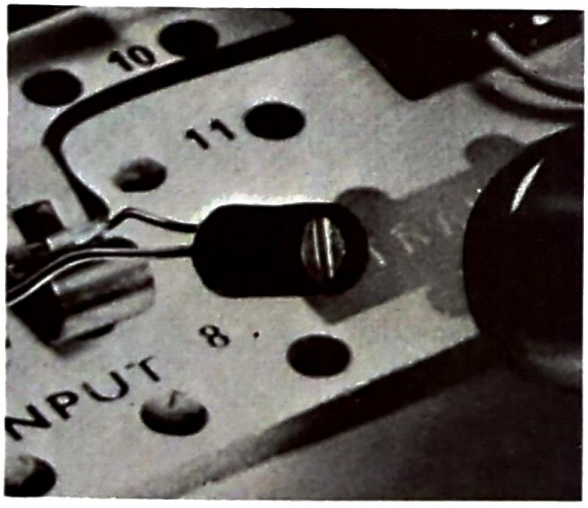
wire or a water-sensing element and connect them to input clips 7 and 8. Turn power switch on. If you use the wires and touch their free ends to a dry object, there'll be no response. But touch something wet and a bleat from the speaker indicates the presence of moisture.

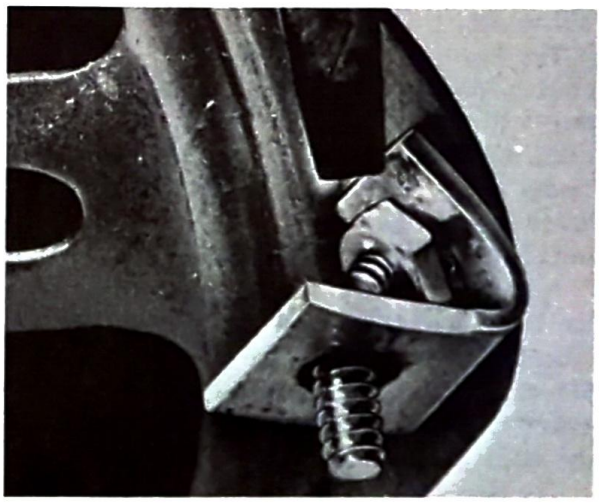
2. *Music Maker.* Try your skill at electronic music with this circuit. Any tune can be played after a bit of rehearsal. When clips 7 and 8 are jumped together, the tone control knob can produce a considerable change in tone from low to very high pitch. This serves as the musical scale.

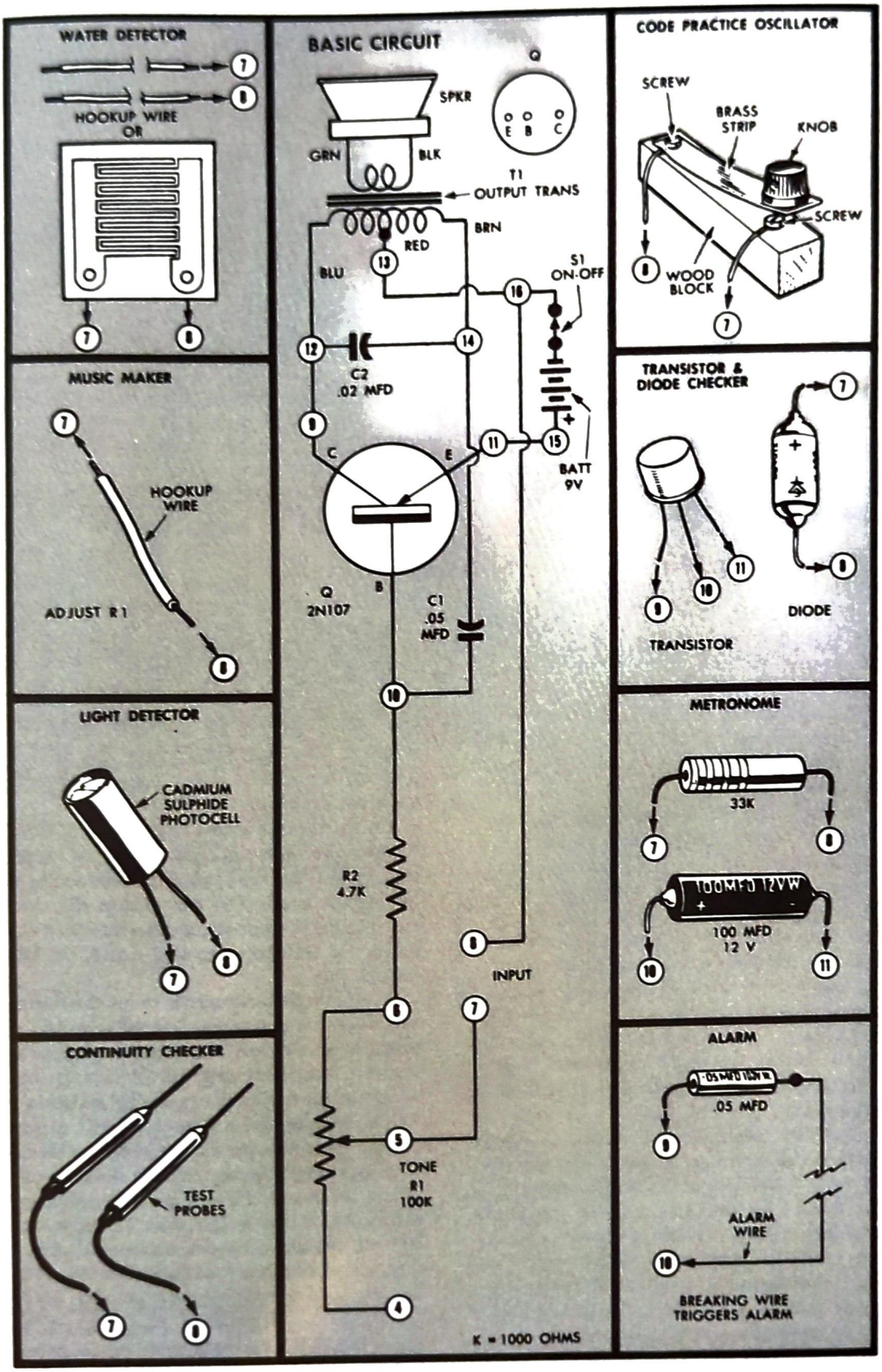
PARTS LIST

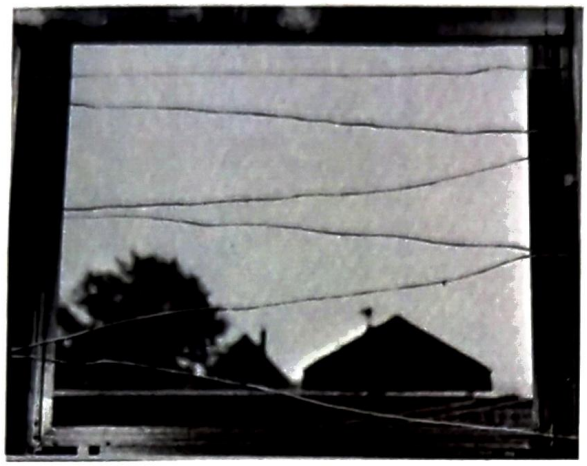
R1—100,000-ohm carbon potentiometer
R2—4700-ohm resistor, ½-watt
C1—.05 mfd paper capacitor
C2—.02 mfd paper capacitor
Q1—2N107 transistor (or any audio PNP general purpose unit)
S1—Single-pole single-throw toggle switch
T1—Audio output transformer, transistor type, 400 ohms center-tapped to 11 ohms (Argonne AR-120 or equiv.)
SPRR—Loudspeaker, 3½″ approx., 3.2-ohm voice coil, PM type
BATT—Battery, 9-volt (Burgess 2U6 or equiv.)
Misc.—Parts not shown in schematic, cadmium sulphide photocell, 33,000-ohm resistor ½-watt, 100 mfd electrolytic capacitor 12 VDC, .05 mfd paper capacitor; approx. 20 Fahnestock clips (H. H. Smith No. 553 or equiv.); hardboard 12″ x 5″; wood strips as shown; 6-32 x ¼″ machine screws and nuts; No. 6 solder lugs.

Light falling on the miniature cadmium-sulphide photocell sets loose a tone from the speaker. You can vary the pitch with the tone-control potentiometer. Overbend a standard 90 deg. bracket to make mounts for the loudspeaker. Insert screws before making the final bend or you'll have trouble later

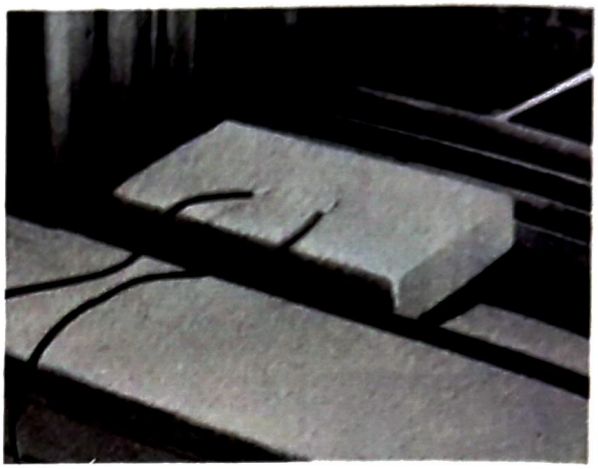





WATER DETECTOR
HOOKUP WIRE
OR
MUSIC MAKER
HOOKUP WIRE
ADJUST R1
LIGHT DETECTOR
CADMIUM SULPHIDE PHOTOCELL
CONTINUITY CHECKER
TEST PROBES
BASIC CIRCUIT
SPKR
GRN
BLK
Q
E B C
T1
OUTPUT TRANS
BRN
RED
BLU
S1
ON-OFF
C2
.02 MFD
BATT
9V
C
E
B
Q
2N107
C1
.05
MFD
R2
4.7K
INPUT
TONE
R1
100K
K = 1000 OHMS
CODE PRACTICE OSCILLATOR
SCREW
BRASS STRIP
KNOB
SCREW
WOOD BLOCK
TRANSISTOR & DIODE CHECKER
DIODE
TRANSISTOR
METRONOME
33K
100 MFD 12 V
ALARM
.05 MFD
ALARM WIRE
BREAKING WIRE TRIGGERS ALARM



Fine wire is strung across an open window for the burglar alarm. If the wire is broken, the circuit is activated and the speaker sounds a warning



Insert the two water-detector leads into a dry sponge and place it on a window sill. If it starts raining, the sponge gets wet and the alarm sounds

electronic experiments, continued

Two playing techniques greatly improve the musical sound. First is vibrato—the knob is rapidly quivered with the hand as each note is played. This eliminates some of the electronic "flatness" of the tone. Also, the jumper wire at the in-put terminals may be lifted at the end of each note to enhance the quality of the musical effect.

3. *Light Detector.* A cadmium sulphide photocell across clips 7 and 8 will respond to light changes. With the cell in place, normal room light should cause the tone to sound. But cup a hand over the cell and the tone ceases.

4. *Continuity Checker.* The board can check for broken connections in household appliances. If the a.c. plug is touched to clips 7 and 8, continuity is signaled by the tone. An important step during such tests is to turn on the appliance's power switch to complete its internal circuits.

5. *Code-Practice Oscillator.* A telegraph key wired to clips 7 and 8 converts the board into a helpful aid for learning Morse Code. If the tone becomes tedious, turn the Adjust knob and alter the pitch.

6. *Transistor and Diode Checker.* A good test of a questionable transistor is checking its ability to oscillate. Since the board's basic circuit is that of an oscillator, a good transistor plugged into clips 9, 10 and 11 should produce a tone. (Only one transistor may be inserted at a time.) An important qualification is that the transistor must be a PNP type. To test an NPN transistor, reverse the battery connections.

Testing diodes is done by placing the leads across clips 7 and 8 *both ways.* The tone sounds for one direction only if the diode is good. If it is heard in both positions the diode is shorted. No tone at any time indicates an open diode.

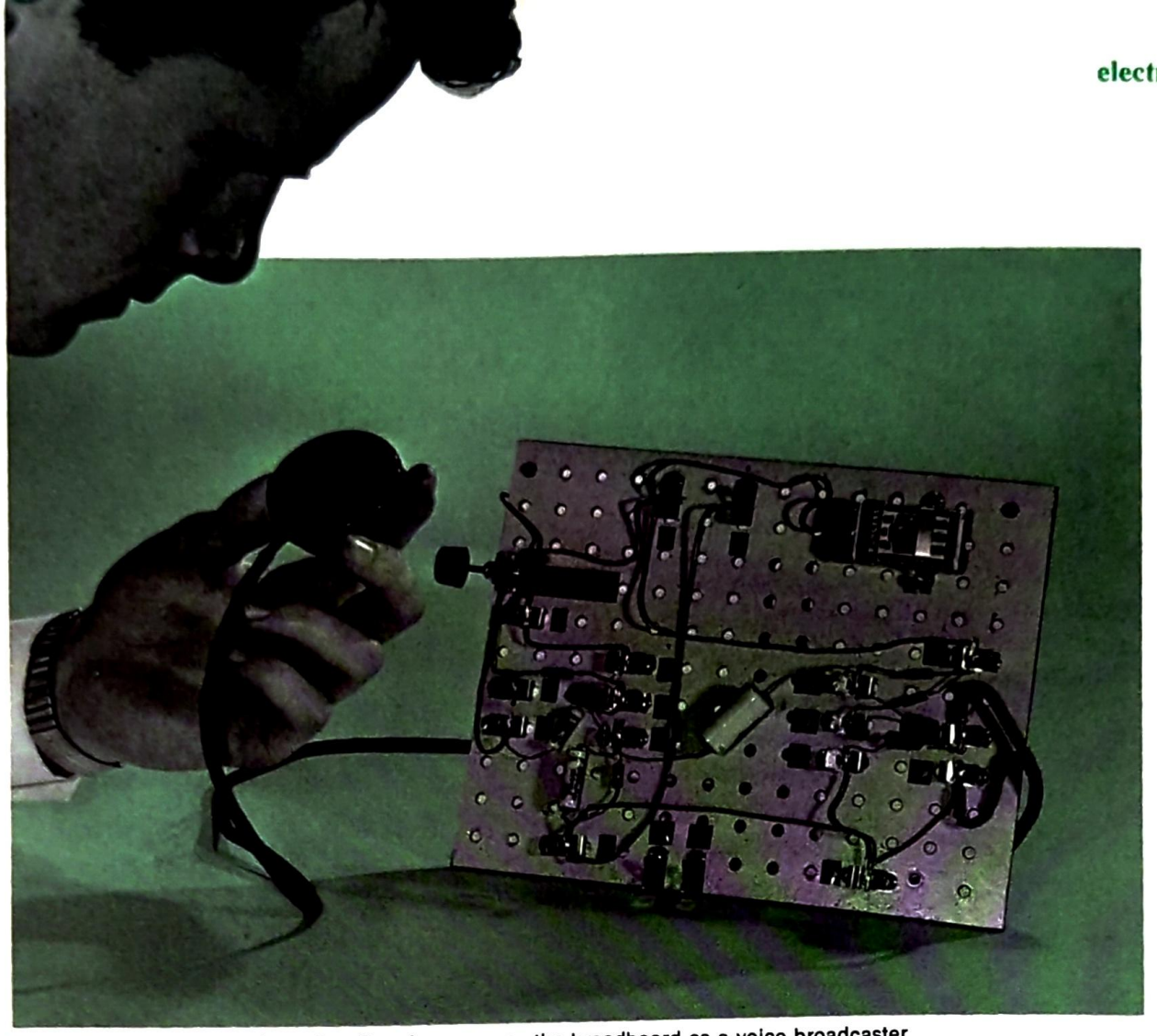
7. *Metronome.* It is possible to slow down the tone frequency until a sharp ticking is heard. Since these pulses of sound repeat at regular intervals, the device can perform as an electronic metronome for setting the beat during music practice. Two additional parts are needed: a 33,000-ohm resistor and a 100-mfd electrolytic capacitor (rated at 12 VDC).

Tie the resistor across clips 7 and 8. Connect the capacitor between clips 10 and 14 (negative lead to 14). Set the rate of the metronome with the Adjust knob. You can change the over-all speed range by choosing a different resistor. The higher the resistance across 7 and 8, the slower the tick rate.

8. *Alarm.* One capacitor equips the board for sounding an alarm when a circuit is broken. The practical application is stretching a fragile wire across a door or window.

Set up the board by mounting a clip in any free hole near clip 9. Place a .05-mfd paper capacitor from the new clip to clip 9. The alarm wire, any length, is run from the new clip to clip 10 on the board. Finally, place a jumper wire across clips 7 and 8. When the power is turned on and the alarm wire remains unbroken, no tone will sound in the loudspeaker.

See also: alarms, burglar; cabinets, speaker; high fidelity; high fidelity center; high fidelity, portable; radio repair, AM; radio, stereo FM; soldering; switch control box.



The earpiece becomes a dynamic mike when you use the breadboard as a voice broadcaster. The setup is the basic wiring arrangement illustrated in Fig. 1. To increase the transmitter's range, add an antenna to clip 1

Five-way radio breadboard

BY LEN BUCKWALTER

HERE ARE FIVE electronic projects for the price of one. The secret's in the breadboard. Fitted with spring clips, it lets you shift parts around, create new circuits in minutes or restore old ones. Total cost of all components is about $6. The only other item required is an AM radio—tabletop or portable.

It's needed in several experiments to pick up transmitted signals.

Preparing the board begins with mounting all clips. Their positions remain the same for all projects. Since connections are wired "by the numbers," label each clip, as shown. Next, mount the tuning coil (L1). Its three lugs must be soldered and connected to the correct clips as shown in the schematic diagram. While attaching these leads, also solder capacitor C1 into place from lug 1 to lug 2. These coils come with a variety of control knobs. If yours has a metal knob replace it with a plastic one.

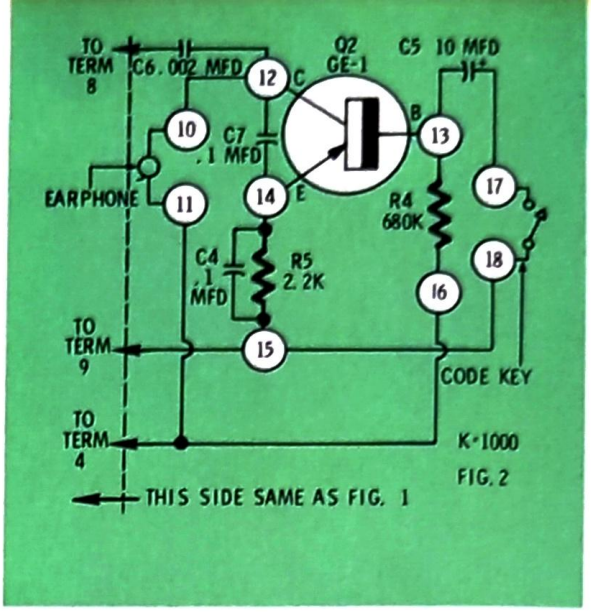
The battery is held in place by a strip of sheet metal bolted to the board. Two leads are soldered to its terminals. When you do this be sure to observe polarity carefully or none of the experiments described here will work. One battery lead, the positive one going to lug 5, serves as the on-off switch. Whenever the board is being rewired or is not in use, disconnect this lead to prevent shorts or unnecessary battery drain.

When wiring up the experimental circuits, you'll find that using the clips is much easier if you press them open with the tip of a screw-

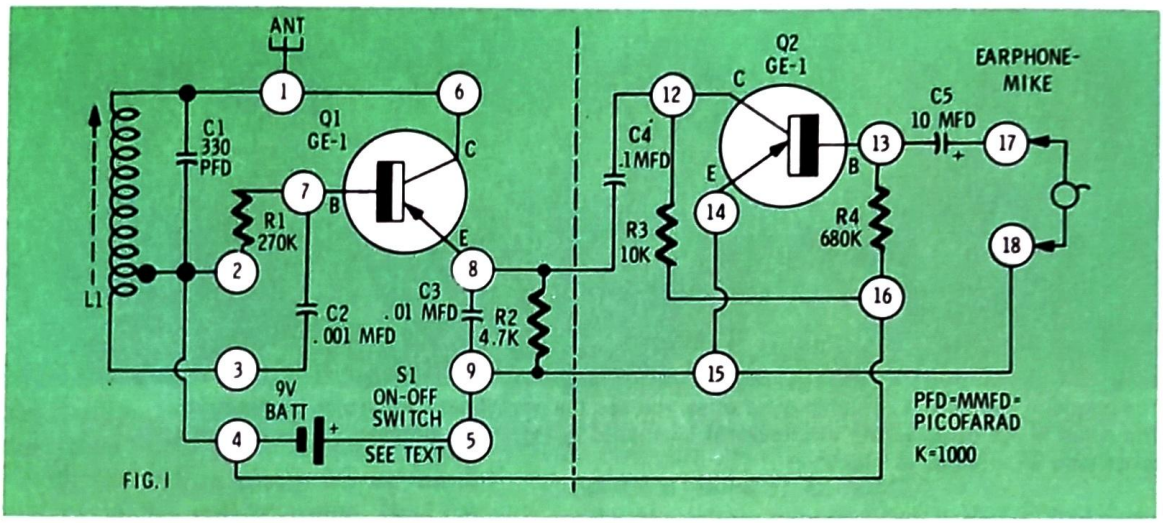
driver, rather than with your fingers. Slide the transistors into place after doublechecking the connections for their three leads.

voice broadcaster

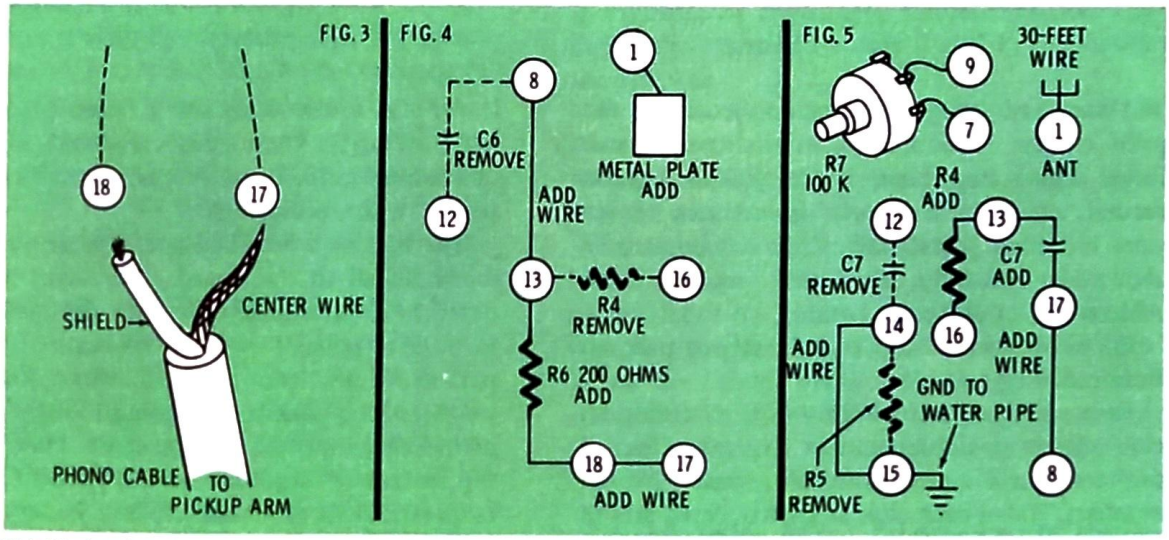
Set up the board following the wiring in Fig. 1. After all connections have been checked, apply power by sliding the positive battery lead into clip 5. Then turn on your AM radio and tune it to a clear spot on the dial. Set the volume control for a normal listening level. (Place the radio a few feet from the board at this time.) Now pick up the earphone (it is used as a microphone here) and holding it close to your mouth, speak into it. As you talk, rotate the tuning knob on coil L1 completely through its range. You will



When you change the wireless mike to a code transmitter you'll have to rewire the second transistor stage. This is the new wiring setup



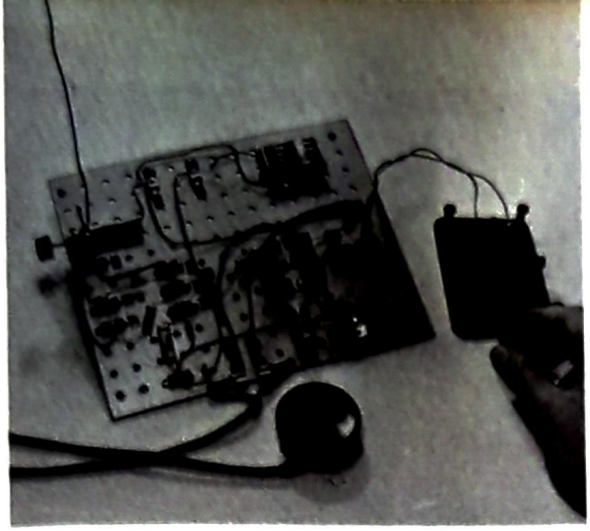
Here's the start. When your breadboard is set up following this wiring arrangement, you have a wireless mike (a voice transmitter). All the other circuits derive from this one, so refer back to this when making other changes



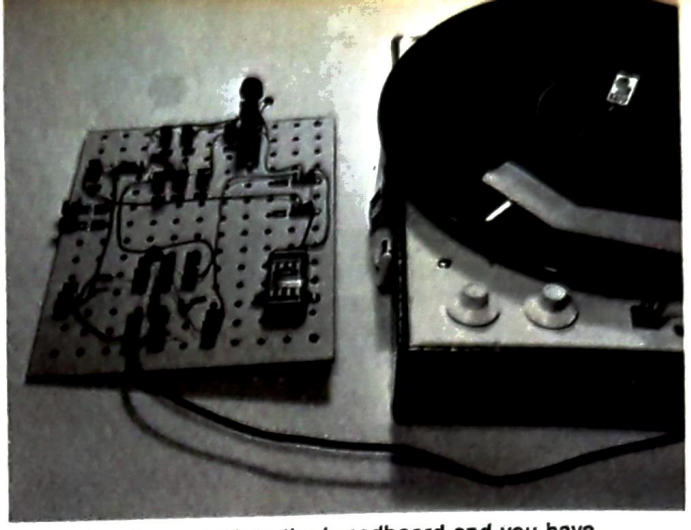
Shielded cable is used to connect a phono cartridge to the input of the transmitter circuit

Touch alarm is set up by making circuit changes. The dashed lines show what to remove

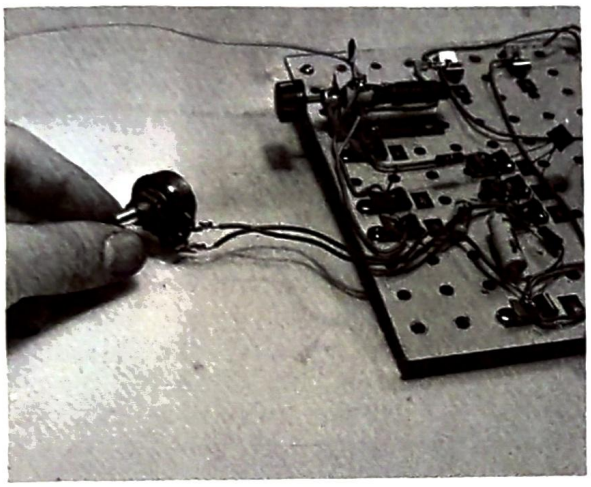
Little 2-transistor receiver also calls for wiring changes. Follow this sketch and the text



Add a key, make a few minor circuit changes and you can practice Morse code either by listening in with the earphone or on a nearby AM table radio



Connect a phonograph to the breadboard and you have a small wireless transmitter that will broadcast recorded music to any AM radio receiver in the house



Want a 2-transistor AM regenerative radio set? Just make a few more wiring changes and there you have it. Add a 30-ft. antenna for best reception

hear signals at several tuning points but only one of these is correct. It is readily identified as it is the only one that produces the voice, *loud and clear,* in the radio speaker.

It's possible to switch your transmission to any desired portion of the broadcast band. Simply screw in the tuning knob to lower the broadcast frequency and retune the radio receiver to pick it up.

The range of the little broadcaster is several feet. This can be increased by adding a short length of hookup wire to coil terminal 1. Do not add an antenna that is more than five feet long or the transmitted signal will violate FCC rules on such low power broadcasts.

phono oscillator

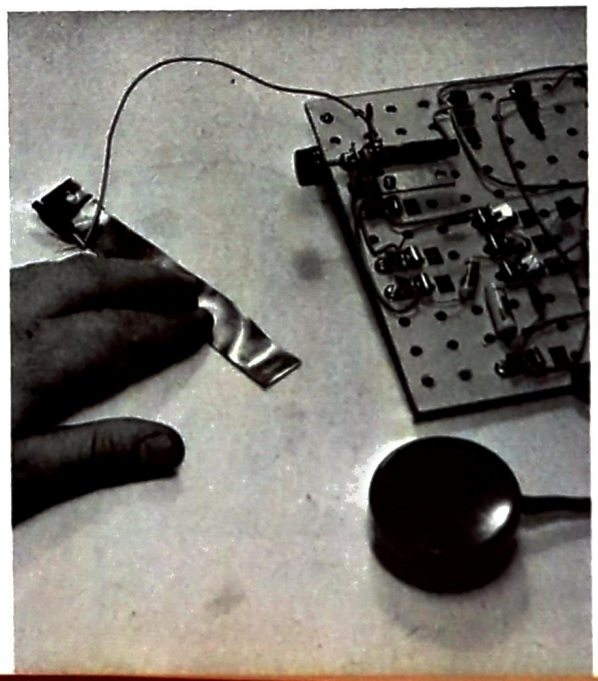
A simple conversion adapts the voice broadcaster for transmitting music from a phonograph to the radio. Remove the earphone from clips 17 and 18. Then connect a shielded cable from the phono cartridge in the pickup arm to these terminals as shown in Fig. 3. For best results use a crystal type phono cartridge to insure a strong signal.

code transmitter

Unlike most code transmitters, the one shown in Fig. 2 produces an audible tone in an ordinary AM radio without the specialized circuits of a communications receiver. Instead, the transmitter generates an audio tone which is then applied to a radio-frequency carrier for transmission. If used for code practice, the receiver may be in another room listening to signals on the radio as the sender operates the key. The sender needs no radio since he hears the identical tone in his earphone.

Much of the earlier circuit (Fig. 1) surrounding transistor Q1 remains the same, but the sec-

With the touch-alarm assembly, a light touch of a finger on the metal trigger plate sets off an audio tone, which is heard from the earphone



ond stage around Q2 is rewired as shown in Fig. 2. Just compare Fig. 1 to Fig. 2 to determine the new connections. When testing the completed circuit and tuning it to the radio receiver frequency follow the same procedure as for the voice broadcaster. Use a screwdriver to short terminals 17 and 18 during this adjustment. Shorting these terminals produces a steady transmitted tone. After you are set up, connect a key at this position and you're ready for practice.

touch alarm

In this circuit, the touch of a hand on a metallic object triggers an alarm tone. Although it doesn't use the AM radio, it relies on radio waves for its operation. The audio tone is heard in the earphone. In operation, radio-frequency oscillator (Q1) is disabled by the electrical disturbance introduced by the hand. Voltages on the transistor change and "unlock" the audio oscillator that is formed by Q2.

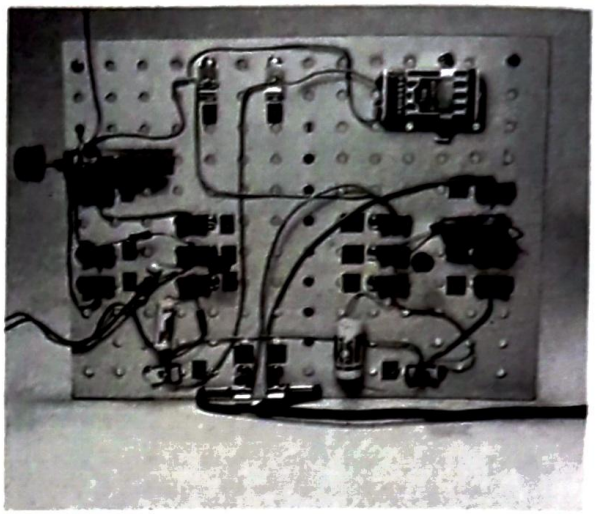
A complete circuit for the alarm is not shown since it is set up merely by making the following modifications to the code transmitter in Fig. 2. Details of these changes are shown in Fig. 4.

Starting with the code transmitter, remove R4 from clips 13 and 16. Next, remove C6 from clips 8 and 12. Now install R6 (200 ohms) between clips 13 and 18 and add a wire from 17 to 18. Also attach a metal plate or other metal object to a short lead connected to terminal 1. A tone will be heard as soon as the plate is touched, triggering the alarm. Sometimes sensitivity can be improved by connecting an additional wire from clip 9 to a nearby ground (like a cold-water pipe). If the tone does not cut off when the plate is not touched increase the value of resistor R6 until it does.

Adding one component and making a few modifications to the touch alarm converts the board to a 2-transistor AM receiver. It is a regenerative circuit and has reasonably good sensitivity. Transistor Q1 becomes an oscillating detector while Q2 serves as an earphone amplifier.

Parts List

R1—270,000 ohms, ½-watt resistor
R2—4,700 ohms, ½-watt resistor
R3—10,000 ohms, ½-watt resistor
R4—680,000 ohms, ½-watt resistor
R5—2,200 ohms, ½-watt resistor
R6—200 ohms, ½-watt resistor
R7—100,000 ohms, carbon potentiometer
C1—330 PFD, 600 volts, ceramic disc capacitor
C2—.001 MFD, 200 volts, paper capacitor
C3—.01 MFD, 200 volts, paper capacitor
C4, C7—0.1 MFD, 200 volts, paper capacitor
C5—10 MFD, 15-volts, electrolytic capacitor
C6—.002 MFD, 200 volts, paper capacitor
Q1, Q2—GE-1 transistors
L1—Tapped transistor coil (Superex VLT-240)
BATT—9 volts (Burgess 2U6 or equivalent)
Earphone—1,000 ohms, PM type
Miscellaneous: perforated hardboard 7 x 9 inches; 18 Fahnestock clips (H. H. Smith 553); 6-32 x ¼" machine screws and nuts; No. 20 hookup wire



Here's the 5-way circuit board set up for use. The earphone doubles as a mike. Minor changes in wiring convert the circuit to perform its other varied tasks

radio receiver changes

Assuming that the board is set up for the code transmitter, follow this sequence of circuit changes. Fig. 5 also acts as a guide. Remove C7 from 12 and 14. Remove R5 from 14 and 15. Remove key from 17 and 18. Install R4 between 13 and 16. Install wire from 14 to 15. Install C7 from 13 to 17. Install wire between 17 and 8. Solder two wires to the middle and one end lug of R7 (110K potentiometer) and hook these wires to 7 and 9. You'll also need a long antenna, about 20 or 30 ft. of wire connected to terminal 1. Run a ground wire from 15 to a cold-water pipe. While listening to earphone, start turning the coil knob through its range. As this is done vary the setting of the potentiometer. This is the regeneration control. If it is set too high there will be an annoying whistle behind each station tuned. With a little practice you'll be able to find the correct setting for each station.

There you have your five radio circuits. You may find some of them so interesting that you'll want to set up that particular circuit permanently. If so wire it up on a perforated phenolic board without the connecting clips.

Should you want to make permanent versions of several of the circuits, experiment with one board to see how much you can condense the physical layout. This way, rather than spreading everything out on one flat plane, you might find ways to fit the circuit into a smaller but deeper space—the phono oscillator in the base of the turntable, for example, so it will be portable.

Steep stairways needn't be an agony for the elderly or the handicapped. A chair lift is no luxury when you build it yourself from angle iron and a battery-operated boat winch

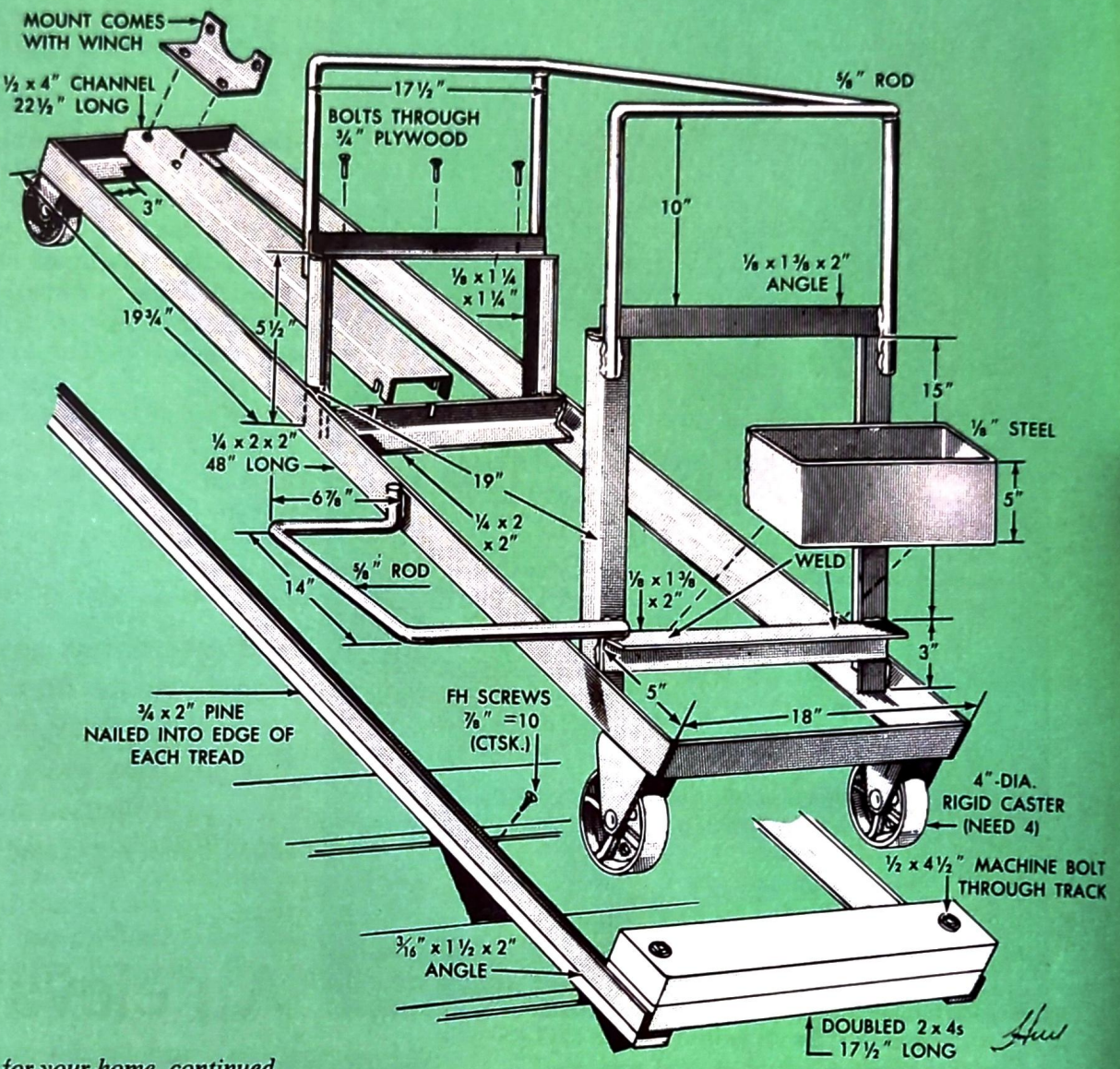
An elevator for your home

BY F. KIRK PERROW, JR.

■ COMMERCIAL stair-climbers have been a feature in wealthy households for some years, but the purchase and installation costs have always been prohibitive for the average home.

Ironically, it's in the more modest home that a straight, steep staircase presents the greatest problem: There's seldom space to spare for a ground-floor bedroom, so the older person or convalescent must either struggle up and down

ASSEMBLY PLAN FOR TRUCK AND TRACK



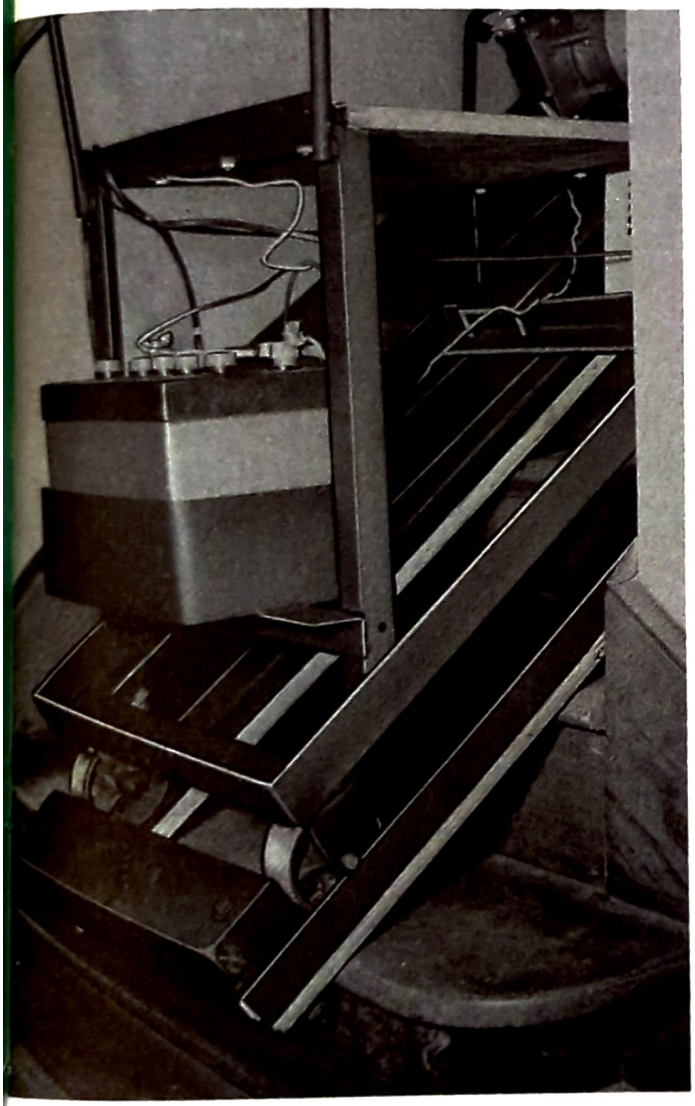
elevator for your home, continued

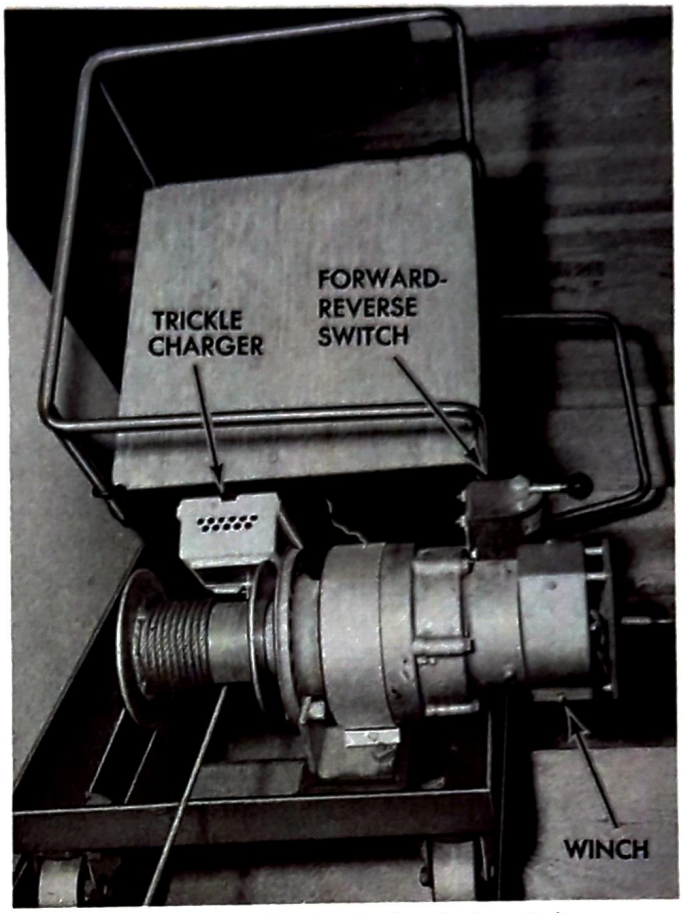
For strength, safety and durability, the little truck is welded. However, you don't need your own welding equipment to complete this interesting project. Simply examine the parts shown in the illustration above, then cut the angle iron and rod to the required lengths. Take these parts to a machine or welding shop, along with the drawing. All of the welding can be done for you at a nominal charge

the steps or become resigned to imprisonment upstairs, cut off from the life of the house.

It was our goal, therefore, to present a stair-lift made of inexpensive materials from plans simple enough for any do-it-yourselfer to follow. You don't need your own welding equipment for the assembly. The original builder merely cut the angle iron and rod to length and took these parts —plus the four casters—to a local machine shop. The welding charges will average about $25. To avoid any tricky mitering or bending, all angles were cut square and lap-welded at corners. Only one joint was given special treatment—the lower end of the winch-support channel. For extra strength, the channel is locked into the cross angle by means of mating slots, prior to welding, as shown on page 906.

When parked at the base of the stairs, the truck rests against a double 2 x 4 spacer located between the tracks. Note how the battery cradle is centered on the seat rail and needs no bottom support panel



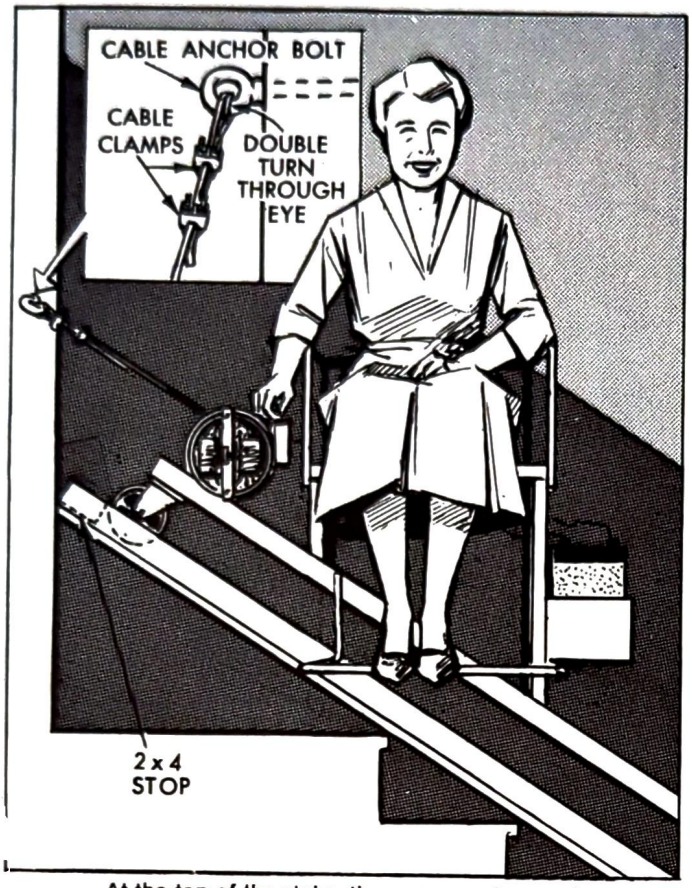


Going up, the seat rides level while the winch reels in the cable, pulling the truck smoothly along the track. The winch switch, with a handle attached, is mounted within easy reach of the passenger

This homemade device can't, of course, compete with commercial models as far as appearance and compactness are concerned. Most of these have wall-hugging tracks and fold-up seats that leave the stairway unobstructed when they're not in use. Our rugged version requires permanent installation of a double track—angle iron screwed to a bed-strip that bridges the stair treads. Whether the truck is parked at the base or the top, it squats across 2 ft. of the stair width, with a center track exposed. However, the stairway will still accommodate foot traffic.

The truck is pulled up the incline by means of a cable wrapping itself around a revolving drum. The drum is a standard boat-trailer winch that operates off a 6- or 12-volt auto battery. It's activated by a 1-hp., 220-V. forward-reverse switch. A trickle charger, plugged into house current overnight twice a week, keeps the battery at full charge. It can be attached to keep it handy.

The battery hitches a ride in a cradle welded



At the top of the stairs, the upper casters nudge a 2 x 4 stop as the winch is switched off by the passenger, who then extends one foot to the landing and steps off. The top cable anchor is critical

elevator for your home, continued

to the lower side of the seat frame. The one shown in the photograph is a length (about 48 in.) of sheet steel wrapped around the battery and welded to the seat brace.

As shown in the lower photo on page 907, the track ends just below the bottom tread. You'd trip over it if it extended to the floor. To determine track length, measure from this tread to a point above the top landing that will best position the chair for stepping on and off. In most cases, this dimension will also be the cable length, but buy enough extra to allow about 10 wraps around the drum. The cable shown is ¼-in. wire-core, capable of supporting over 5000 lbs. The winch is a government surplus item, purchased for under $50, including the mounting bracket. It has a clamp inside its drum to anchor the cable.

Perhaps the most critical step in the installation is anchoring the *upper* end of the cable. No screw-eye or staple plate could, of course, withstand the dead-weight tug of truck-plus-rider. In the installation shown, a long anchor bolt, secured from the local power company, was passed completely through the door frame at the top of the stairs, and two nuts were locked snug against a large washer. This type of bolt has the advantage of a cast eye. Be wary of the standard wire eye-bolt with an unwelded eye you can force open.

heavy-duty anchor bolt

However, a heavy-duty version, formed of ½-in. rod, should be plenty strong without an eye weld. If you can't locate such a bolt, you can order one by mail from a building specialties concern. Specify ½-in. brass or steel rod and give the shank length.

If you have to anchor at a hall corner, you may have to open a small patch of wall to discover how long a shank you'll need, and to turn the nuts against the face of the stud. The bolt must, of course, be located directly at the top of the stairs. If the stairs form a T with an upper hall, for example, the anchor couldn't be placed on the wall facing them, since this would stretch the cable across the hall passage. The *height* at which the bolt is located should be such that the cable roughly parallels the incline of the track. This means the anchor will be about the height of the top of the winch drum.

take safety precautions

In order to keep this project within the scope (and budget) of the average home workshop, construction has not been complicated with elaborate safety accessories. It is assumed you will take precautions similar to those employed by the builder who designed the original model of this lift, and has enjoyed safe operation in his home for two years. These precautions involve thorough testing after installation (before instructing any elderly persons in the mechanical operation) and frequent checking of the cable, winch and dead anchor. If there are adventurous children in the house, you may want to back up your don't-touch admonition with a practical deterrent such as a lock switch, or a hinged cover that can be padlocked.

See also: stairs

Make an ellipsograph

BY WALTER E. BURTON

■ WITH THIS ellipsograph it takes just one sweeping stroke to draw a perfect ellipse of exactly the size you want. Not only that, you can set the gadget up on your jigsaw or bandsaw and cut just as perfect elliptical shapes from plywood or solid stock. You don't buy it; you make it in your own shop from materials you may already have at hand.

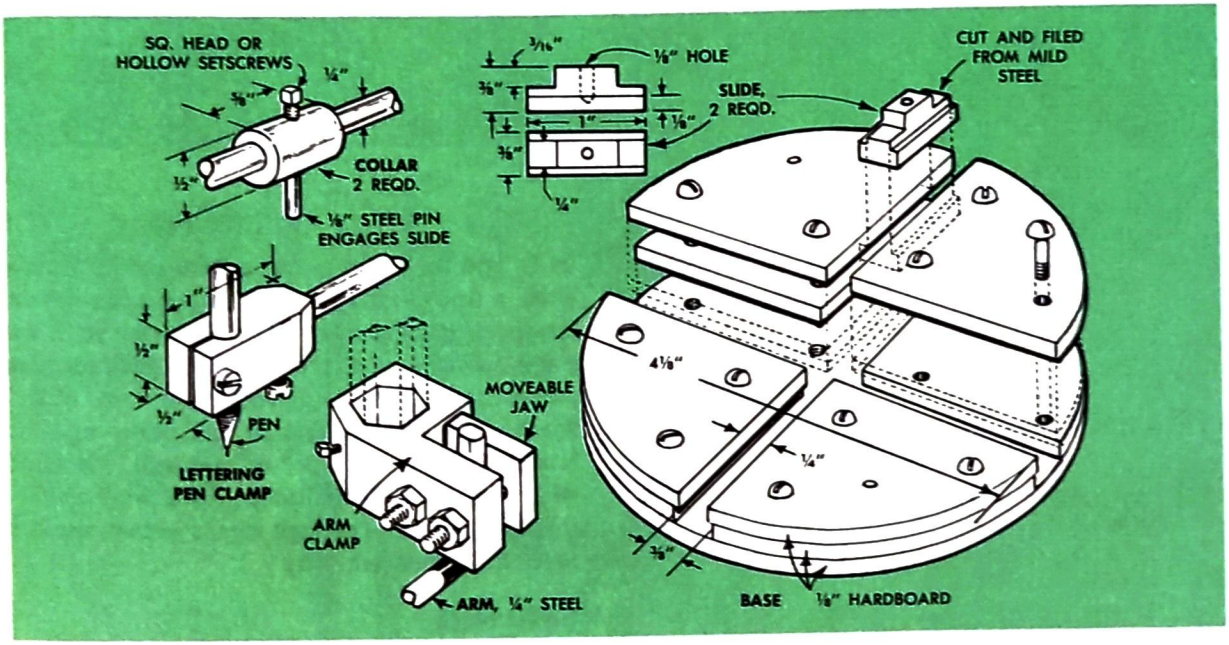
The ellipsograph, or elliptic trammel, pictured consists of a base built up sandwich-fashion from a disk and segments cut from hardboard. Note that segments are in two sizes, four of each size. The parts are arranged and screwed together to form two perpendicular T-slots intersecting at the center of the built-up base as you see detailed below. Two steel slides engaging mounted sleeves carry an adjustable arm which in turn carries the pen and pencil clamp.

All parts must be made accurately so that when assembled the steel slides work freely in the T-slots. Slides are easily made from mild steel with a file and fine-toothed hacksaw. The lettering-pen clamp and arm clamp should be cut and filed from metal.

For drawing an ellipse with a pen or pencil in the holder the arm can be any convenient length. For cutting elliptical forms on a jigsaw or bandsaw the length of the arm is, of course, limited by the swing of the saw.

Use only tempered hardboard for the parts of the base. Plane and sand the edges of the segments and seal with lacquer.

See also: drafting equipment; tracing projector.



enclosure, privacy: see sun lounge
enclosure, radiator: see home improvement; radiator covers
enclosure; speaker: see cabinets, speaker
end tables: see step table; tables
engine idling: see idling, auto

Midget steam engine

BY MANLY BANISTER

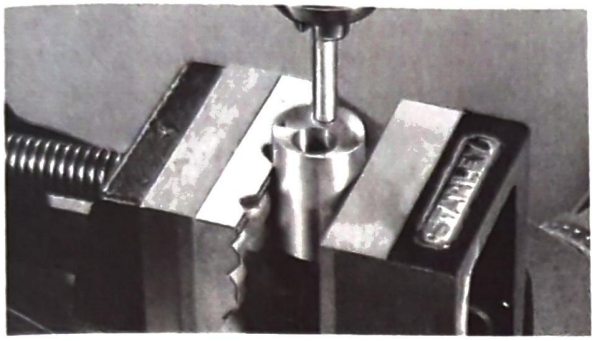
You needn't be a skilled machinist
to make this perky little one-lunger
from the detailed plans we have here.
It'll bat along at 1200 rpm
for 20 minutes on a boiler filling

■ IF YOU HAVE ACCESS to a 6-in. modelmaker's lathe, a drill press and a jig saw, you can have a lot of fun making this midget powerhouse. It's a single-acting, piston-valve-type reciprocating steam engine with a ½-in. bore and ⅝-in. stroke. Machining has been kept to minimum—and the boiler is literally a "pipe" to assemble: it's made of standard plumbing fittings. Fired with a blowtorch, it generates enough steam in two minutes to set the pistons whirring.

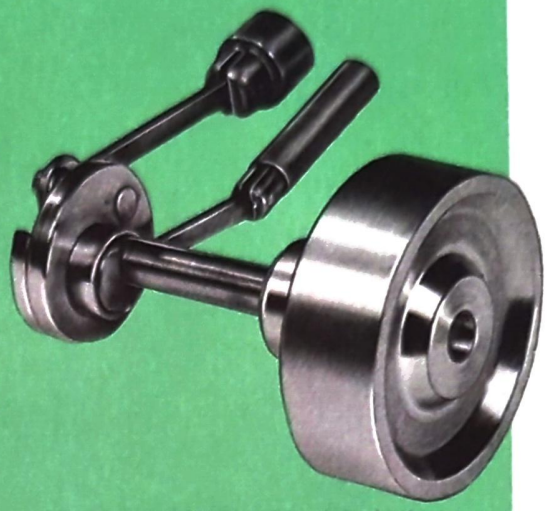
engine block

The trickiest machining is boring the two holes—for cylinder and steam chest—in a piece of bronze bearing stock. After cutting the rod to approximate length, face both ends and scribe a diameter across what will be the lower end. Prick-punch centers for the two bores. Bore the cylinder as shown on the opposite page drilling 1 1/16 in. deep with a ⅛-in. drill; then enlarge to that depth with successively-larger drills, switch-

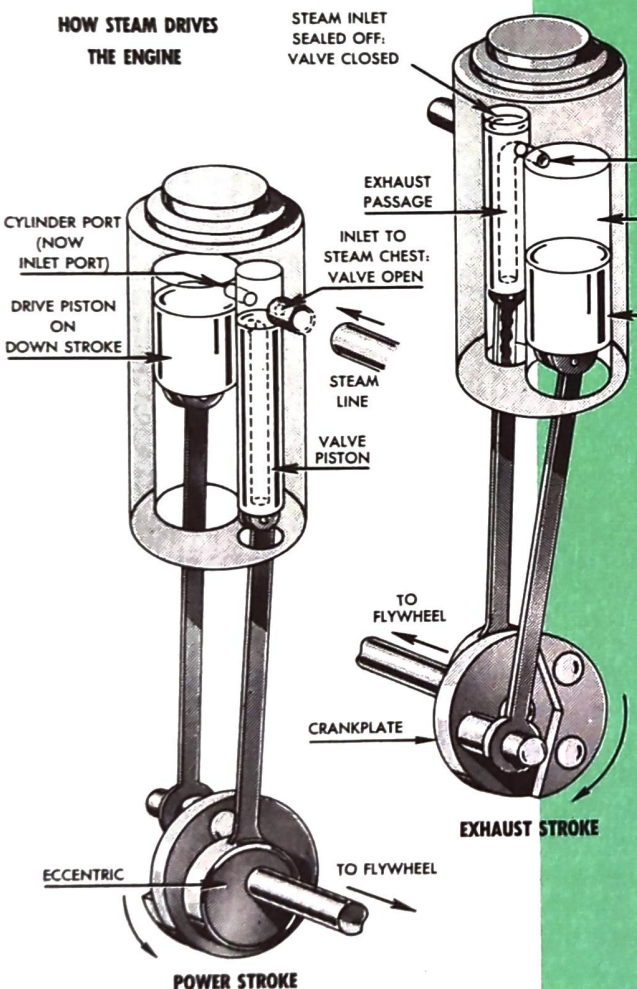
Mount the engine block off-center in a four-jaw chuck to bore the cylinder on a metal lathe. Use a series of drills from ⅛ to ⅜-in. Finish with boring tool



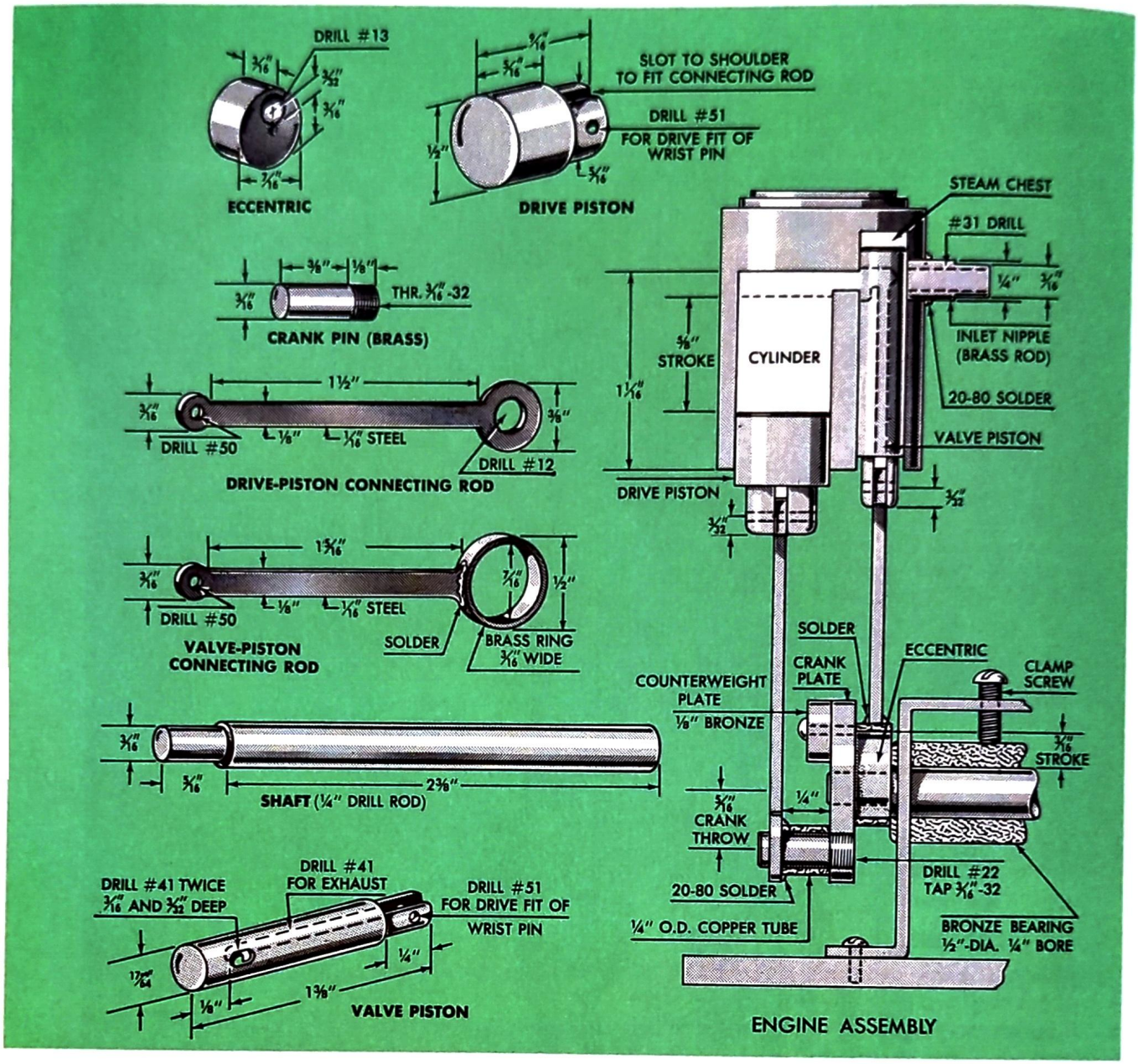
To lap the steam-chest bore, the block is held in vise that's secured to the drill-press table. Final lapping rod is converted into a valve piston for perfect fit



The crankshaft assembly, detached from the engine block, shows how the connecting rods link the pistons to the crankplate. Both the plate and the eccentric are soldered to flywheel shaft



Exaggerated see-through sketches show two extreme positions of the pistons. At far left, drive piston has just begun power stroke, forced down by steam rushing through the steam chest, above retracted valve piston. Revolving eccentric is about to raise valve to cut off steam flow. Expanding steam in cylinder continues to push drive piston to bottom of stroke. In second sketch, engine is viewed from opposite side to show how energy stored in the flywheel thrusts drive piston upward. Valve position, now at the top of its stroke, presents exhaust passage to port between steam chest and cylinder. Rising drive piston forces steam down valve's hollow core and out the base of the bore



midget steam engine, continued

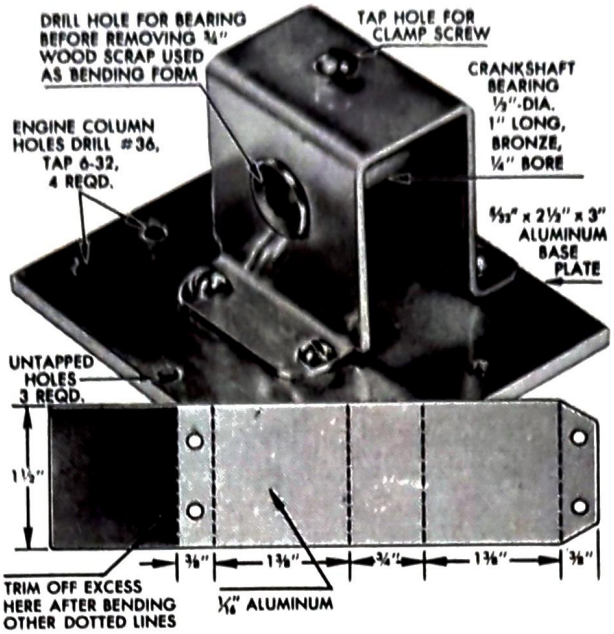
ing to a boring tool for a finish diameter of ½ in. Exact diameter isn't critical; the piston will be machined to fit.

Remount the block so the steam-chest punch mark is centered, and drill 1¼ in. deep with a ¼-in. drill. Transfer the work to the drill-press vise and with a No. 41 drill, bore into the side, passing through the steam chest and into the cylinder. Switch to a ¼-in. drill and enlarge the hole into the steam chest only, to provide a seat for the steam-inlet nipple. Machine this nipple from a ¾-in. length of brass rod and insert it until it butts the far wall of the steam chest. Anchor it with 20-80 solder.

This solder is 20 percent tin and 80 percent lead, and melts at a temperature of 532 deg. F. Don't use ordinary 50-50 solder as it has a much lower melting point that can't withstand the heat of the engine block. You can't get 20-80 solder commercially, so make your own by melting together 1 oz. of 50-50 bar solder and 1½ ozs. of lead (fishing sinkers are fine). Stir the molten mixture and pour it into a simple mold, such as a blind saw kerf in the face of a board. Later, when you sweat the steam line to the nipple, buy 40-60 solder to avoid the risk of melting.

Now, with a 17/64-in. drill, drill out the steam-

An ignition-point file is chucked in a jig saw to finish off the connecting rod. For easy handling, piece is worked while still attached to parent strip of sheet metal. After filing, cut rod free. Use the same setup to file connecting-rod slots in pistons. At right is bearing block


DRILL HOLE FOR BEARING BEFORE REMOVING ¾" WOOD SCRAP USED AS BENDING FORM
TAP HOLE FOR CLAMP SCREW
CRANKSHAFT BEARING ⅛"-DIA. 1" LONG, BRONZE, ¼" BORE
ENGINE COLUMN HOLES DRILL #36, TAP 6-32, 4 REQD.
5/32" x 2½" x 3" ALUMINUM BASE PLATE
UNTAPPED HOLES 3 REQD.
1½"
⅜"
1⅜"
¾"
1⅜"
⅜"
TRIM OFF EXCESS HERE AFTER BENDING OTHER DOTTED LINES
1/16" ALUMINUM

chest bore, right through the soldered-in nipple, to the full 1¼-in. depth. Since a drilled-out bore is far from perfect, you must finish it to size. A better method than reaming is to *lap* the bore. First, machine from ⅜-in. drill rod a 1½-in. long cylinder that just fits—without looseness—to the full depth of the bore. Using the drill-press setup shown on the first page of this article, coat the rod with oil and dental pumice (available at drug stores) and run it up and down in the bore with the drill press set for 600-800 r.p.m. After a couple of minutes, replace this first rod with one machined a few thousandths larger—big enough to stick when you try to insert it in the bore. Apply oil and pumice as before, but lap *only* until the rod can be run down the full depth of the bore. Back off immediately and flush out the bore with kerosene or paint thinner. This final rod is made into the valve piston.

valve piston

Cut the rod to length and mount it in a three-jaw lathe chuck. Face the cut end and center-drill to within 3/32 in. of the opposite end, to provide an exhaust passage. Machine the bottom to shape and hacksaw the connecting-rod slot. File this slot to an easy slip fit, then drill for the wrist pin, which can be a 3d finishing nail. Note that the slot aligns with the exhaust passage, forming its mouth.

With the rod in a drill-press vise, drill into the side (at right angles to the slot) to connect with the center hole. This provides the port which will mate with the cylinder exhaust port when the valve piston is at the top of its stroke. Since the valve continues to rise slightly during this exhaust operation, you must elongate its exhaust port by drilling a second hole overlapping the first, but not deep enough to meet the core hole. Grind out metal between these holes to form the stepped recess shown.

drive piston

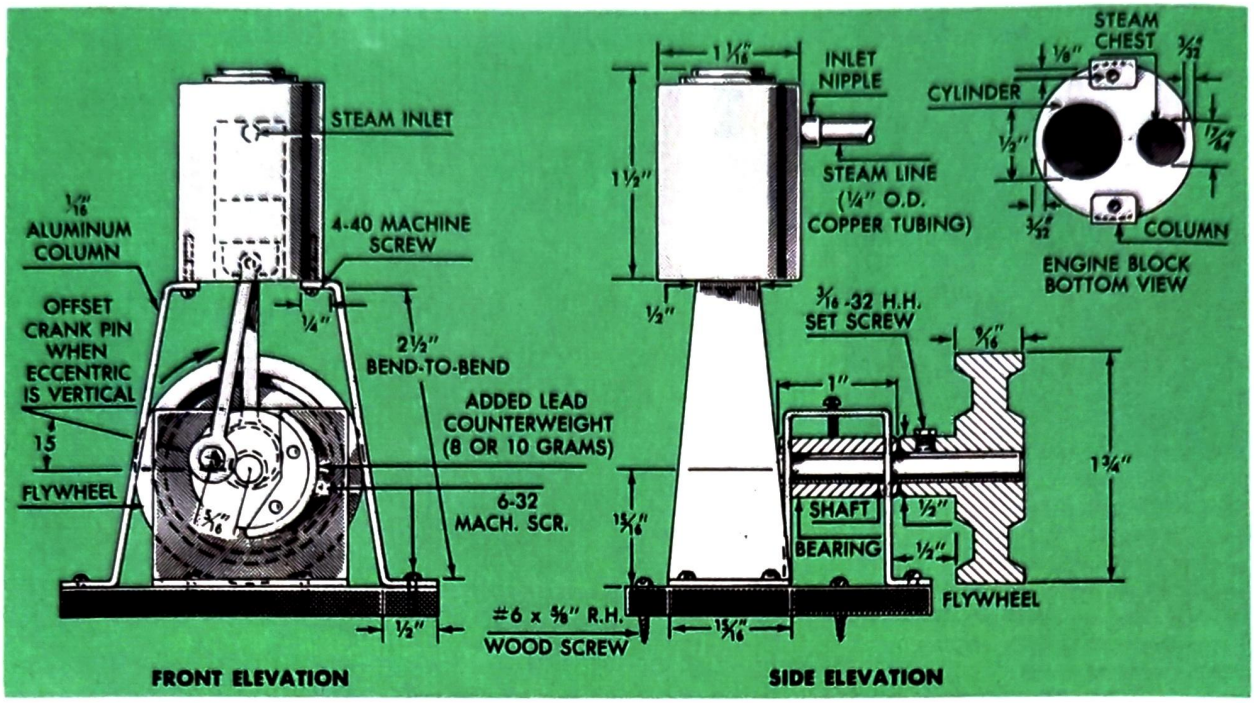
This is machined from ⅝-in. cold-rolled steel rod. To get a good fit (without resorting to a small hole gauge) requires slow, careful machining; toward the end, take the diameter down half a thousandth at a time. That's half the space between adjacent marks on the numbered cross-feed thimble. For top performance, the final fit should be so tight that the piston must be lapped into the bore.

Shape and slot the bottom as with the valve piston, then trim to the length shown in the detail and face the cut surface.

connecting rods

Lay out the drive-piston rod and the flat section of the valve-piston rod on ⅜-in.-wide strips of 16-ga. sheet metal. Rough-shape with a coarse file, then do final shaping with an ignition-point file chucked in a jigsaw. Smooth with emery crocus cloth, and polish on a buffing wheel.

The brass eccentric ring for the valve rod is formed by hollowing out ½-in. brass rod, then cutting off a 3/16-in. width.



crankshaft assembly

To make the eccentric, machine the end of ½-in. drill rod, remove from the lathe and drill to accept the reduced end of the shaft. Then return to the lathe and cut the eccentric to width. It must be a smooth, sliding fit inside the valve rod's brass ring.

The crankplate is turned to 1-in. dia. from the same bronze stock as the engine block, and cut off ⅛ in. thick. Cut off a second disk, trim off a segment for the counterweights, and rivet this to the crankplate, filing the rivets flush with the rear surface.

Thread the brass crankpin tightly into the socket tapped near the opposite edge of the crankplate. This, too, should be filed flush at the back—after punching several points around the edge of the socket to prevent unscrewing. To provide for an additional counterweight, drill and tap the counterweighted edge for a 6-32 screw.

Assemble the connecting rods to their respective pistons by cutting off the point of a 3d finishing nail and driving it through piston and rod; cut off the nailhead close to the piston, and peen both ends. The rod should swing freely.

The main bearing can be made from oilite bearing stock, or can be purchased as a stock-size bearing. In either case, lap the shaft into an easy-turning fit.

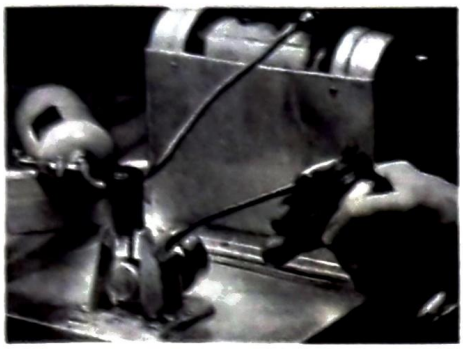
Once the crankshaft assembly is complete, insert the two pistons into the engine block, and the shaft through its bearing. With the columns attached only to the underside of the engine block, position the feet on the base plate by trial, holding them down while turning the shaft to check piston function. Then tap for screws.

The engine at this initial-assembly stage is shown in the inset on the opening page. There is still an additional counterweight to add. For satisfactory operation, the counterweight on the crankplate of a vertical engine must balance the weight of the drive piston and connecting rod. The bronze segment so far added does little more than balance the weight of the crankpin. If possible, weigh the drive-piston assembly on a gram scale; the lead to be added can weigh a gram or two less. Use sheet lead, or melt a fishing sinker and mold it in a saw kerf. Drill the lead strip at the center and attach it to the counterweight side of the crankplate with a single screw. Wrap it around, trim both ends slightly beyond the counterweight and clinch around the bronze.

engine adjustment

To keep the piston connecting rod riding straight on the crankpin, its lower end has a projecting sleeve. The nominal length of this is given (in the engine assembly drawing) as ¼ in.—which does to start with. In the final assembly, file the free end of the sleeve to give the piston a smooth fit in its bore, without binding.

Use 50-50 solder to join the eccentric to the shaft; then grip the shaft vertically in a vise and



KEEP THE ENGINE OILED

Until the engine gets thoroughly hot, frequent oiling is required. With a squirt-type oil can, apply a few drops of 20-weight crankcase oil on the eccentric as shown. Also keep the bottoms of the pistons lubricated, so that oil is pumped up into the cylinders. The excess will run down the rods to lubricate the crankpin. Continue oiling every few minutes.

push the crankplate on, adjusting the pin position to the 15-deg. offset shown in the front elevation. Apply a drop of 50-50 solder to sweat the plate to the shaft.

If any further adjustment of the valve and piston relationship is needed, it can best be determined by operating the engine. To adjust at this stage, you must melt the solder joint between shaft and crankplate, using the tiniest possible blowtorch flame, and shift the crankplate as required. (That's why high-temperature solder is used on the rod sleeve—to keep it from coming loose when the crankplate is heated.) Keep the eccentric straight up, so the valve is at the top of its stroke, while you tap the crankpin with a small screwdriver.

A double-capped pipe nipple with an underslung coil of copper tubing forms a boiler for this working-model steam engine. This assembly, suspended within an aluminum-sheathed asbestos firebox and fired with an ordinary propane torch, produces a head of steam in about two minutes to set the midget engine whirring.

The boiler's designed to be one of the fastest things you ever built. Its parts are all plumbing supplies available at hardware stores—including standard brass compression fittings for ¼-in. o.d. copper tubing. Before coiling the tubing, attach a fitting to one end and flare the tubing with a flaring tool. Then wrap the tubing four times around a length of 1¼-in. dowel held in a vise, cut off the other end and attach the second flare fitting. The photo and sketch on page 916 show that when it's assembled in the firebox, one end of the coil is higher than the other; this is easily achieved by making the lead to one end shorter. This higher end is located at the rear of the firebox, as it's there that steam is generated. Water passes into the coil at the front end, which is relatively cool compared to the end at the tip of the flame.

Formation of scale on the coil can be minimized by proper firing: Keep the flame off the coil and *never* let the coil turn red hot. Scale tends to insulate the tube from the heat, so knocking it off the coil raises the steam pressure and speeds up the engine.

assemble boiler parts

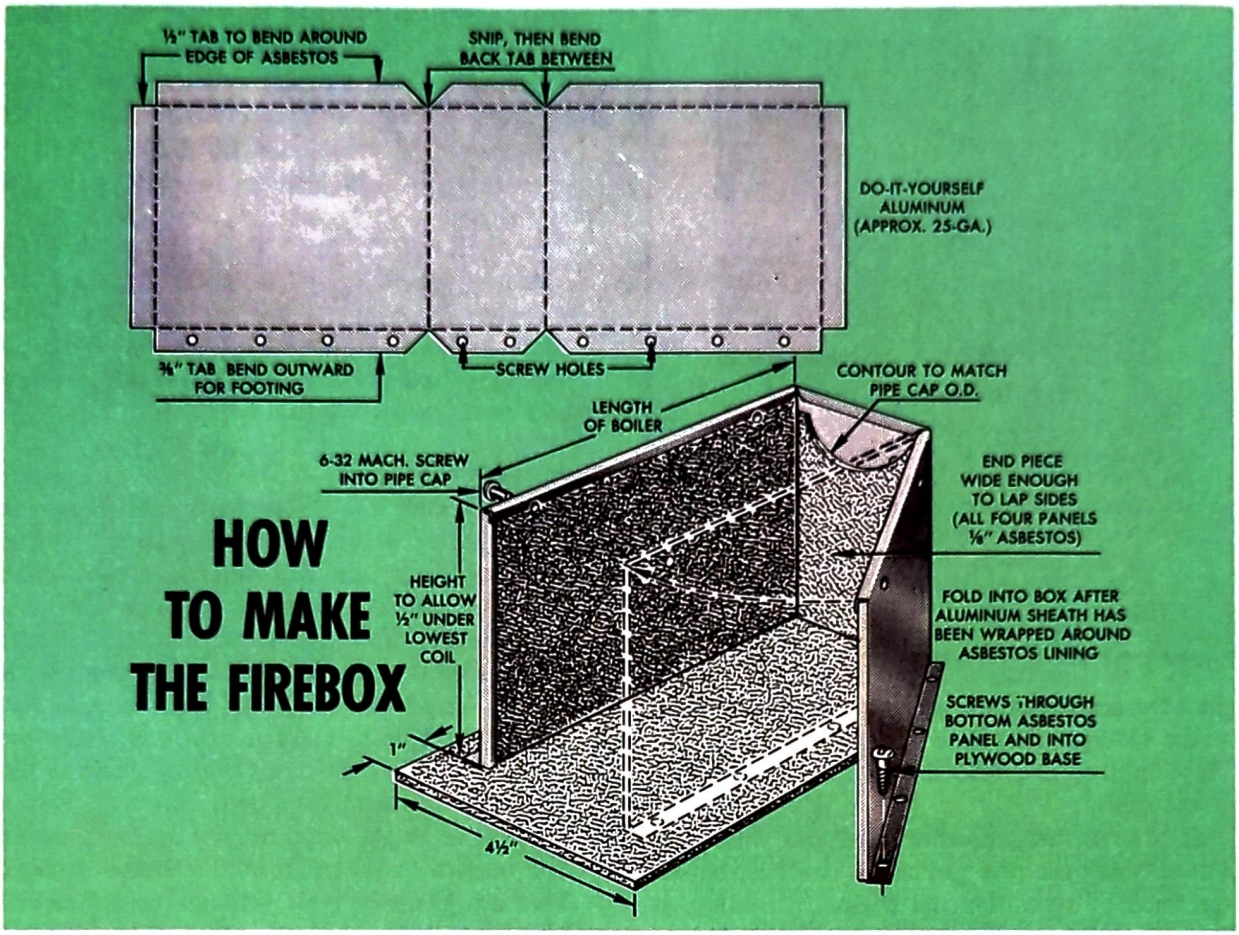
To assemble the boiler parts, put pipe-joint compound on all threads, and turn them up tight. Don't neglect to install a safety valve, as detailed on page 916. The plug is the head end of a plated wood screw, and its hole in the boiler is drilled with a numbered drill only a thousandth or two larger in diameter. File or spot-mill around the hole to make a tight seat under the screw head. The "modern Chinese" curve to the safety-valve arm in the photo (far left) isn't a decoration: When you trim off a narrow piece of thin brass with shears, that's the shape it takes. This arm pivots on a pin through the slotted end of a 5/16-in. brass rod screwed tight in a tapped hole.

If you get careless with the blowtorch and generate too high a head of steam, this simple, positive-acting safety valve will prevent a serious accident.

Three sheathed asbestos panels are folded to form a box, as shown on page 916. The boiler (with coil attached) is suspended inside by means of two machine screws into each pipe cap. The inner cap is also cradled on the contoured edge of the end panel. This assembly is then set on the bottom asbestos panel, which is positioned next to the engine on a platform. This platform is a 9½-by-11-in. piece of ¾-in. plywood, with four ¾-in.-dia dowels glued into holes in the underside. The platform shown in the illustrations has been covered with the same type of aluminum used to sheathe the firebox. This protects the plywood from flame and steam.

To fire the boiler, pour 10 to 12 oz. of water into the filler hole and screw in the plug. Attach a heavy-duty nozzle to a propane torch and set a medium flame.

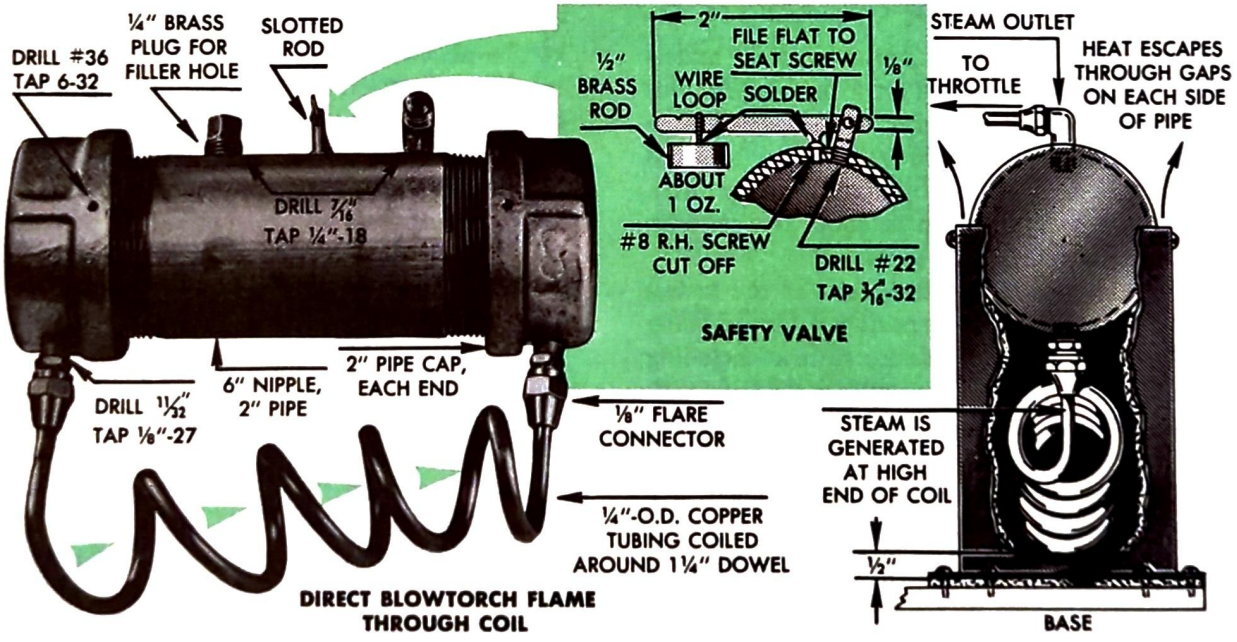
Prop the torch in a small cradle of wood so that the nozzle rests on the first ring of the coil. In about two minutes, steam should start coming


½" TAB TO BEND AROUND EDGE OF ASBESTOS
SNIP, THEN BEND BACK TAB BETWEEN
DO-IT-YOURSELF ALUMINUM (APPROX. 25-GA.)
⅜" TAB BEND OUTWARD FOR FOOTING
SCREW HOLES
CONTOUR TO MATCH PIPE CAP O.D.
LENGTH OF BOILER
6-32 MACH. SCREW INTO PIPE CAP
END PIECE WIDE ENOUGH TO LAP SIDES (ALL FOUR PANELS ⅛" ASBESTOS)
HOW TO MAKE THE FIREBOX
HEIGHT TO ALLOW ½" UNDER LOWEST COIL
FOLD INTO BOX AFTER ALUMINUM SHEATH HAS BEEN WRAPPED AROUND ASBESTOS LINING
SCREWS THROUGH BOTTOM ASBESTOS PANEL AND INTO PLYWOOD BASE
1"
4½"

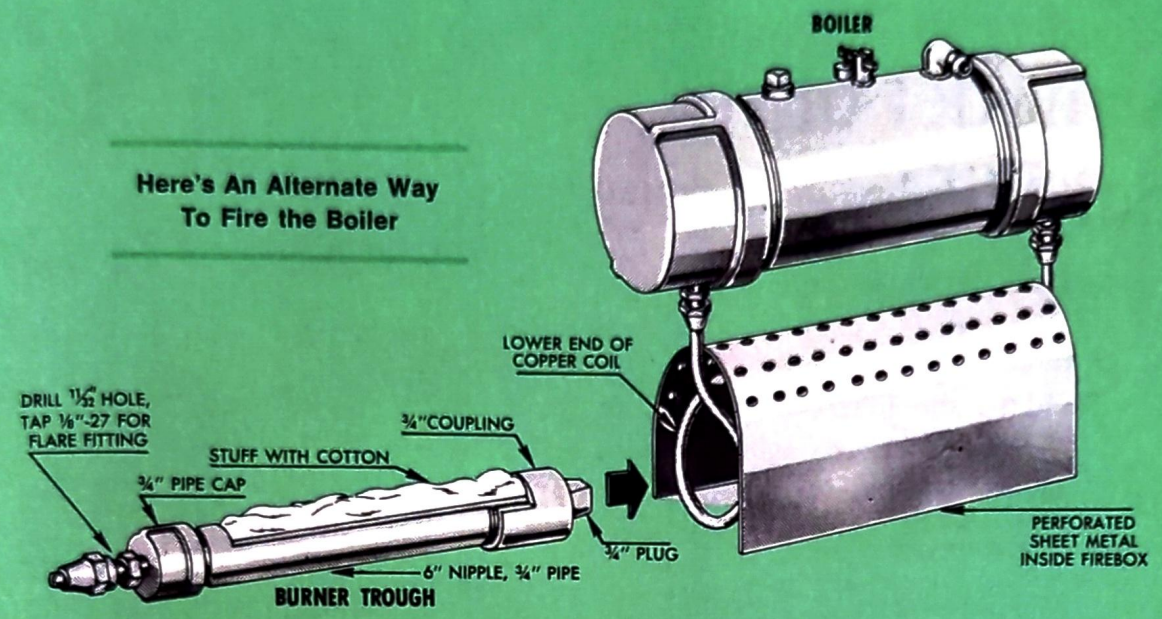
out of the engine. Spin the flywheel several times to pump out the condensation and to heat the engine block.

Once the engine is hot and puffing, no throttle is needed to control its speed. Merely adjust the valve on the blowtorch. You can "pour on fuel" by opening it—then damp the fires by turning it down. For longest engine life, however, keep the flame turned down so that the engine lugs along at about 1200 r.p.m. At this rate, one boiler filling lasts up to 20 minutes.

See also: solar motors.



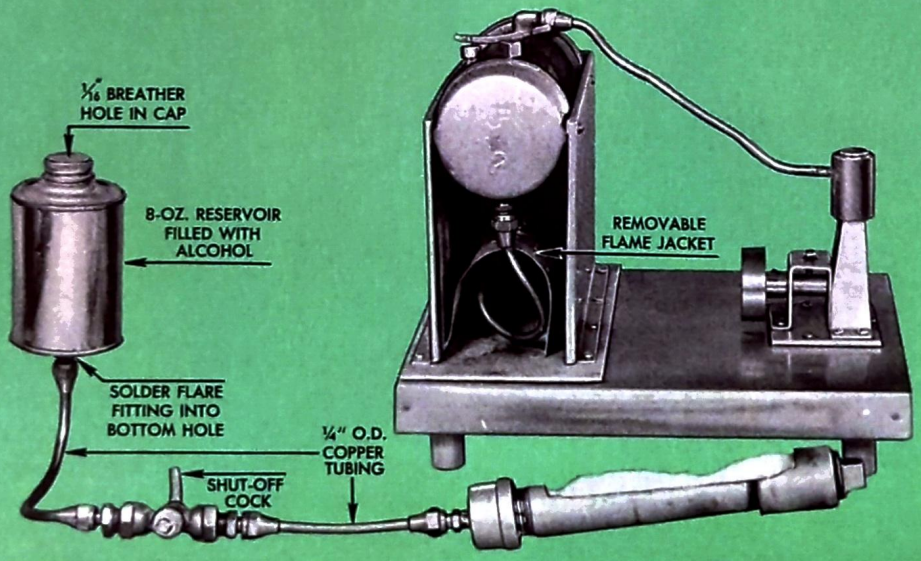
Here's An Alternate Way To Fire the Boiler



If you'd rather not use a blowtorch to heat the coils, you can make an efficient alcohol burner from another pipe nipple and a few fittings, as illustrated above and below. It'll cost you about $3. The nipple is cut away and capped at both ends; the end that goes into the firebox is closed with a coupling and plug, since a pipe cap would be too big to pass through the coil.

Stuff this cut-away assembly with cotton—all the way to the end of the pipe cap, to make contact with the feed line. The shut-off cock provides fuel control. The perforated flame jacket, slipped over the coil before the boiler is set in the firebox, increases the heater's efficiency nearly 100 percent. It needn't be removed if you switch to blowtorch operation.

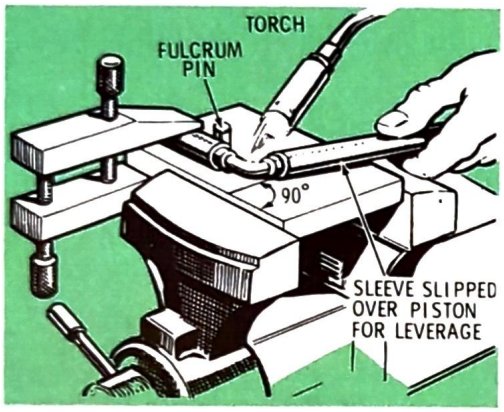
To operate the burner, prime the trough with about two oz. of alcohol. (The shut-off cock is left closed.) When the burner is inserted through the coil, the fit is snug enough to hold the reservoir suspended, without additional support. Whenever the fire starts to die from lack of fuel, open the shut-off cock for a second or two, then close it tightly. This avoids refilling the trough outside the firebox—which could be dangerous while the burner is hot.

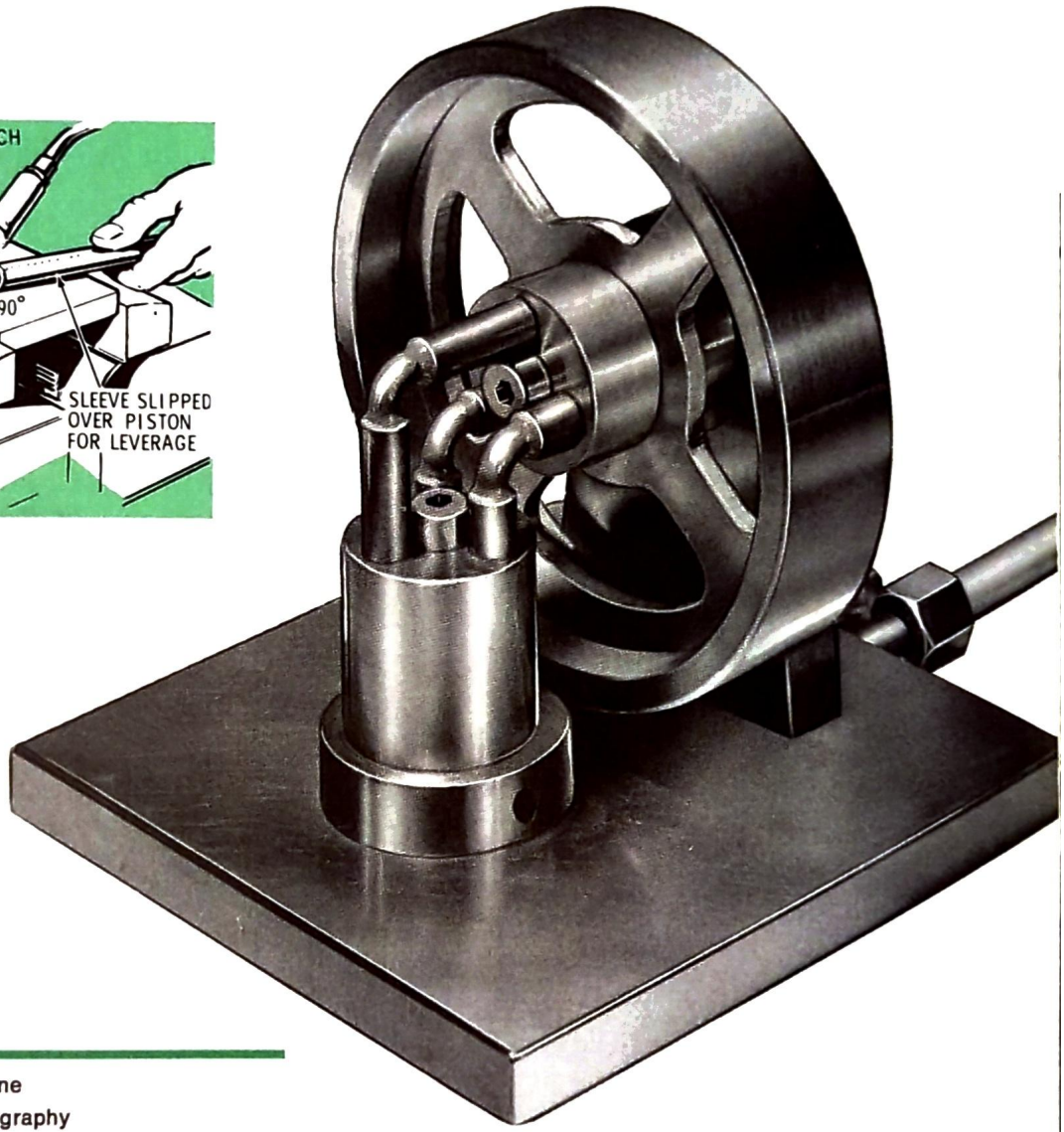

1/16" BREATHER HOLE IN CAP
8-OZ. RESERVOIR FILLED WITH ALCOHOL
REMOVABLE FLAME JACKET
SOLDER FLARE FITTING INTO BOTTOM HOLE
¼" O.D. COPPER TUBING
SHUT-OFF COCK

A model of the incredible elbow engine

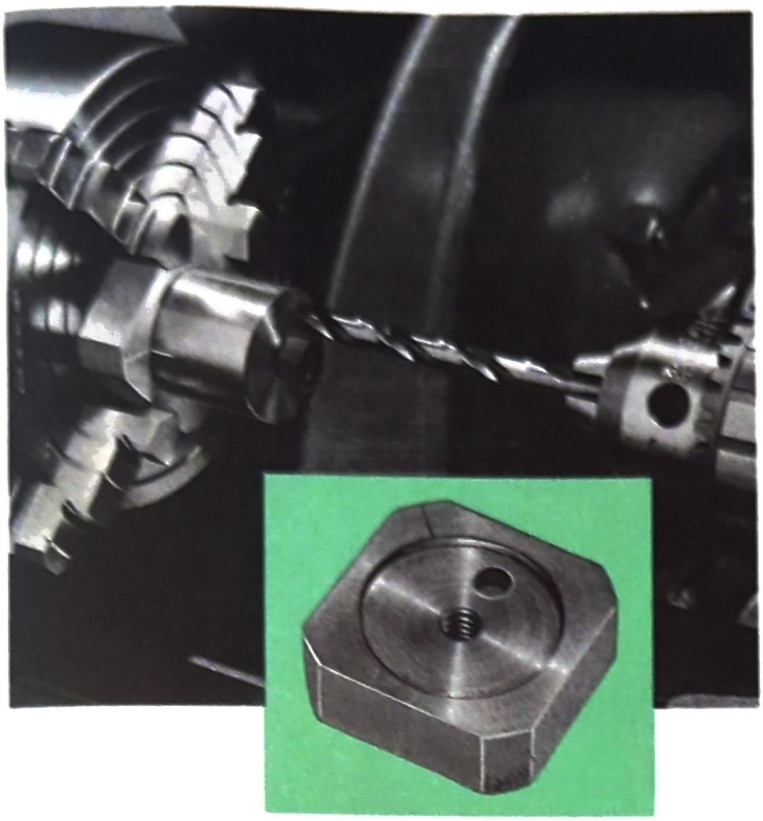
BY JEREMY HARRIS AND WILLARD SLAY

Build this simplified power-maker and you'll be able to ask friends, "Would you like to see a six-cylinder engine that has only five moving parts?"





engine timing: see timing, auto engine
enlarging: see easel enlarger; photography
entertainment center: see high-fidelity center
entryways: see remodeling; room divider; slate floors
epoxy glue: see glues



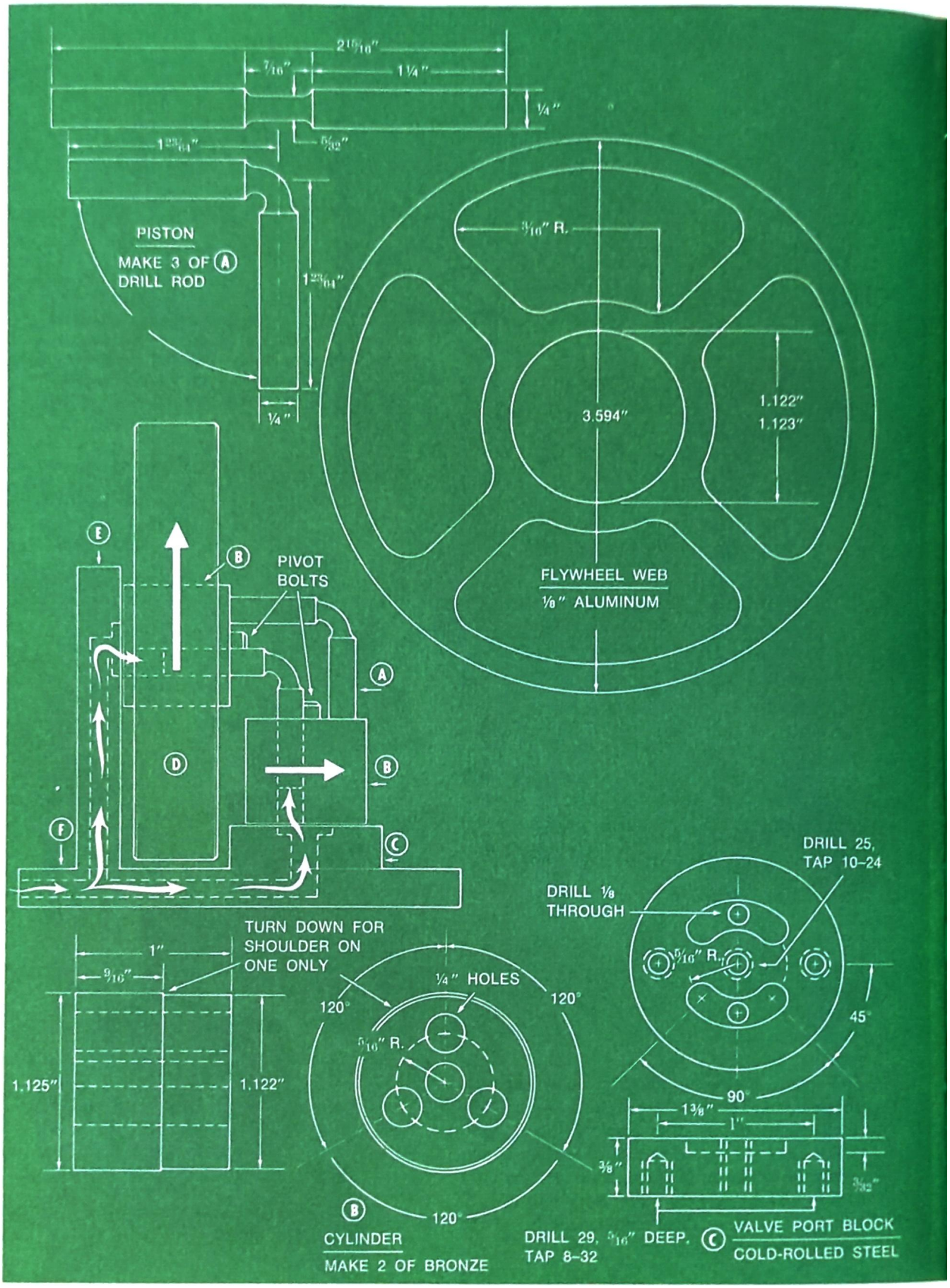
The drilling fixture is just a socket for chucking the cylinder in the lathe. The aluminum one, inset left, has already been used. Before usage there is only the tapped middle hole and an index mark

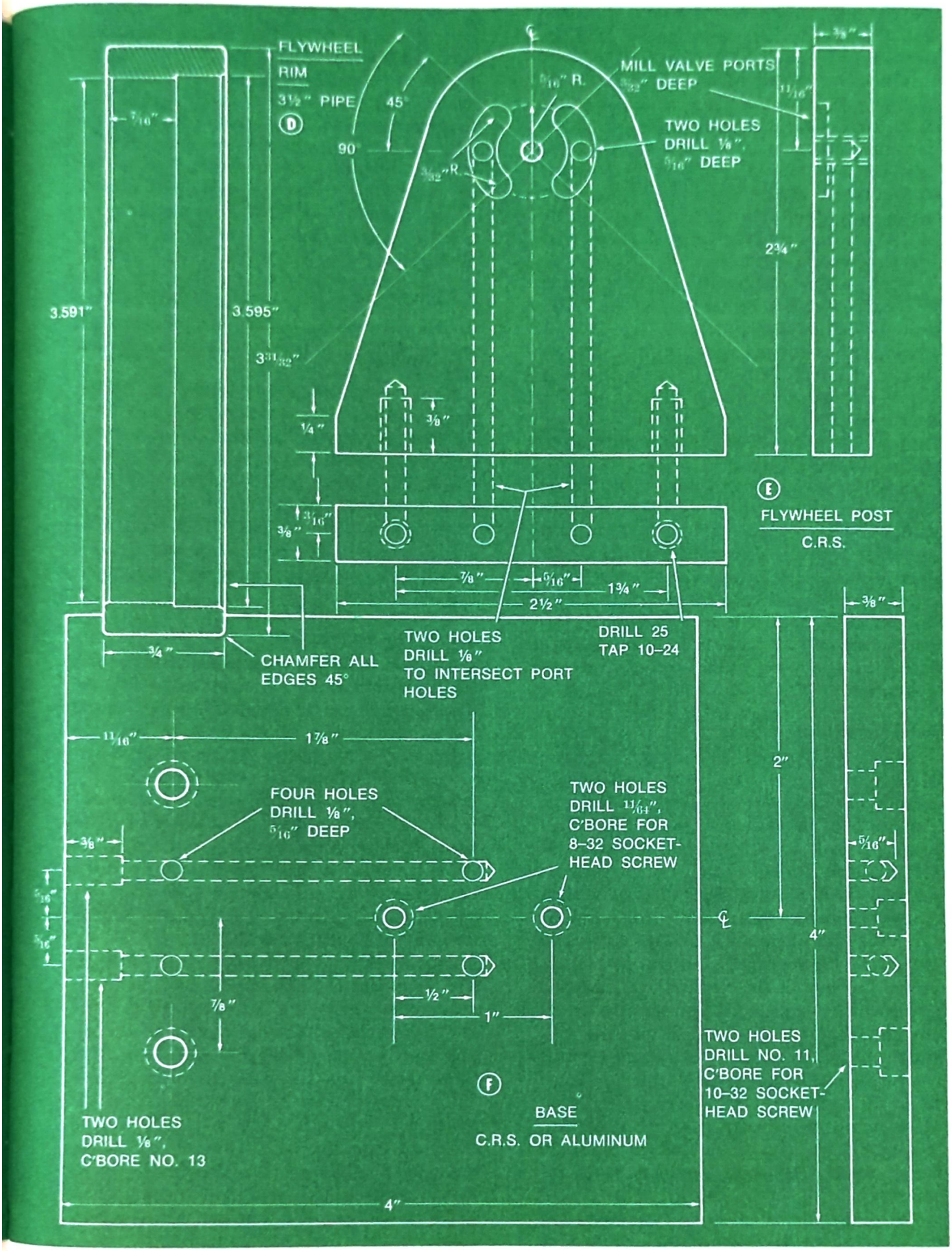
These sequence shots show how two completed cylinders (mounted at right angles) are spun by the in-out action of the elbow pistons, which exert a push-pull force

WITH AN ENGINE as novel as this one, you don't ask, "What's it for?"—it's for motivating you to say "Wow!" after you've hooked it up to an air or steam line and observed what it can do. It's *worth* a "wow," too: This is a six-cylinder engine that has only five moving parts!

The pistons are paired into three elbows that bridge two cylinder barrels. In order to *move* when they're activated, the pistons have to *turn* both barrels; thus back-and-forth motion is converted into rotary motion—without gears. Switch the pressure line (steam or compressed air) to the exhaust port and the whole thing spins in reverse. Either way, there's more elbow action than you'd get from a line of señoritas in a maraca contest.

Valving is accomplished without adding a moving part. There are two crescent-shaped slots in the plates that the cylinder blocks ride against. These slots are spaced so that pistons on an upstroke lie over one of them, while pistons on a downstroke lie over the other. Both ends of each piston pair are actuated simultaneously, so the power-pulse pattern is like a three-cylinder engine. The action is based on a type of constant-


2 15/16"
7/16"
1 1/4"
1/4"
1 23/64"
5/32"
PISTON
MAKE 3 OF (A)
DRILL ROD
1 23/64"
1/4"
3/10" R.
3.594"
1.122"
1.123"
FLYWHEEL WEB
1/8" ALUMINUM
(E)
(B)
PIVOT
BOLTS
(A)
(D)
(B)
(F)
(C)
DRILL 25,
TAP 10-24
DRILL 1/8
THROUGH
5/16" R.
45°
90°
1 3/8"
1"
3/8"
5/32"
TURN DOWN FOR
SHOULDER ON
ONE ONLY
1"
9/16"
1.125"
1.122"
1/4" HOLES
120°
120°
5/16" R.
120°
(B)
CYLINDER
MAKE 2 OF BRONZE
DRILL 29, 5/16" DEEP,
TAP 8-32
(C)
VALVE PORT BLOCK
COLD-ROLLED STEEL


FLYWHEEL
RIM
3½" PIPE
Ⓓ
7/16"
3.591"
3.595"
3 31/32"
45°
90°
℄
5/16" R.
3/32" R.
MILL VALVE PORTS
3/32" DEEP
TWO HOLES
DRILL 1/8",
5/16" DEEP
3/8"
11/16"
2¾"
Ⓔ
FLYWHEEL POST
C.R.S.
1/4"
3/8"
3/16"
3/8"
7/8"
5/16"
1¾"
2½"
3/4"
CHAMFER ALL
EDGES 45°
TWO HOLES
DRILL 1/8"
TO INTERSECT PORT
HOLES
DRILL 25
TAP 10–24
11/16"
1 7/8"
FOUR HOLES
DRILL 1/8",
5/16" DEEP
TWO HOLES
DRILL 11/64",
C'BORE FOR
8–32 SOCKET-
HEAD SCREW
3/8"
5/16"
5/16"
7/8"
1/2"
1"
2"
4"
5/16"
TWO HOLES
DRILL NO. 11,
C'BORE FOR
10–32 SOCKET-
HEAD SCREW
TWO HOLES
DRILL 1/8",
C'BORE NO. 13
Ⓕ
BASE
C.R.S. OR ALUMINUM
4"

velocity joint known as "Hobson's coupling." But the way the pistons dance is what engineers call "simple harmonic motion."

Although a milling attachment is useful for cutting these valve crescents, you can make the entire engine on a lathe alone, working from the over-size plans on pages 920 and 921. For those valve ports, for example, you'd just drill a series of overlapping holes along a scribed arc, using a bottoming drill. (The exact shape and depth of the ports isn't critical, as long as the cylinder barrel covers and seals them.)

Use bronze bar stock for the cylinders. Square both ends of each barrel accurately and finish-turn the outside diameter. Make two identical blanks, and postpone turning down a shoulder on one until later. Drill and ream a ¼-in. center hole in each barrel; then (with use of an indexing head if possible) scribe three axial lines 120 deg. apart on the side of each barrel, running about ¼ in. up from one face.

You'll need the simple fixture shown at the upper right to help space the cylinder bores. Chuck a piece of plate or bar stock which has a face area larger than the cylinder barrels. Machine a 1/16-in.-deep recess to nest—snugly—the base of the barrel. Next, drill and tap a center hole for a ¼-28 bolt. In the recess, make a center-punch mark on a 5/16-in. radius and scribe a single radial line at any one of the corners, as shown in the inset.

fixture turns freely but snugly

Mount this fixture in the lathe so the punch mark is centered; check the recessed face for true running, then use a ¼-28 Allen-head screw to clamp one of the barrel blanks to the fixture, making sure it turns freely but snugly in the recess. Rotate the barrel until one of its index marks is in exact alignment with the radial mark on the fixture, then tighten the bolt and drill the first hole, using a center drill to start. If a reamer is available for running the last few thousandths on the diameter of the cylinder holes, this will give maximum straightness and smoothness. At any rate, work to a close slip fit with the ¼-in. stock used for the pistons. When the first hole is completed, simply loosen the clamping bolt and rotate to the next scribed line on the cylinder. Make the second cylinder barrel the same way, then turn down its o.d., as seen on page 920 in the drawing, to provide a press fit in the fly-wheel web.

The piston elbows are made from ¼-in. drill rod. This material is recommended because of its accurately ground finish and precise diameter. Three pieces are cut to length, faced and necked down in the center to form the elbow of the 90-deg. bend. Keep that section cherry red while bending, and hold the sleeve you've slipped over the unclamped end firmly against the face of the jig to prevent misalignment by twisting.

There are several ways to make a flywheel, but the two-piece construction shown is probably easiest. The rim is 3½-in. steel pipe, with its i.d. reduced enough to form a press-fit shoulder for the aluminum web. The inside bore of the web, on the other hand, provides a press fit for the o.d. of the cylinder barrel. Once this three-part assembly is complete, test it for squareness. If it wobbles, lightly tap the web and rim until the unit runs true.

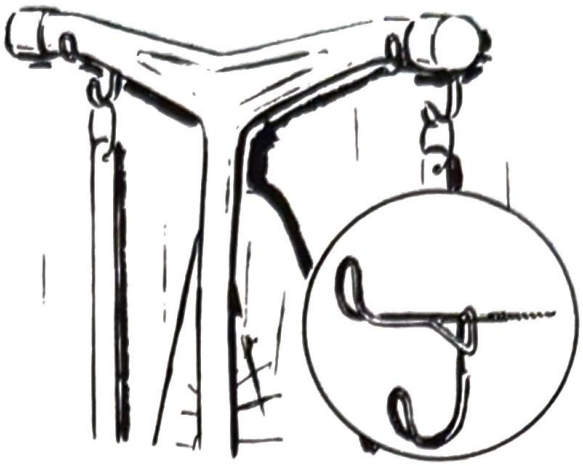
Make the base from ⅜-in. steel plate. Besides the tapped holes for attaching the port block and flywheel support, the base contains drilled passages for intake and exhaust of both cylinder barrels. These passages are identical ⅛-in. holes which run straight in from the back edge. Four short vertical holes intersect them, and mate with passages in the port block and flywheel support. Use thin paper gaskets under these parts to avoid leakage.

find the best arrangement

When assembling the engine, switch the pistons and bores in various combinations to find the best free-running arrangement. The engine should turn smoothly, with very little drag, once the pivot screws are tightened. End play of the barrels should be reduced until they just turn freely; this play can be adjusted either by shimming under the screw heads, or by machining the screw shoulders. Don't be discouraged if a little tuning is needed to make the parts move freely. The action of the mechanism is inherently very smooth, so it's worth some extra time to take full advantage of this characteristic.

Either of the two ports may be used as the intake. Press lengths of 3/16-in. o.d. tubing into the counterbored ports, for attaching the pressure line of your choice. The right load for your engine must be determined by experiment. The model shown runs best when compressed air is regulated to between 20 and 40 p.s.i., and the pistons are kept lubricated with SAE No. 10 motor oil. After you have lubricated, of course, the engine will kick up an oil spray, so it will be wise to do your engine-tuning in the workshop. And wear clothing that you won't mind getting soiled.

Prevent piracy around your feeding station by hanging bells over the tray, as shown above. Small birds will slip between the bells and feed undisturbed, but squirrels or large birds will hit the bells and be frightened off by the noise.



The simplest method of storing an ironing board is to hang it by the legs from a pair of standard wire coat hooks. Bend the top part of each hook upward to prevent the legs of the board from slipping off. The two lower hooks come in handy for hanging brooms, mops, dust pans, etc. This arrangement not only keeps your broom closet neat, but also keeps the ironing board from falling over.

This shaping sheath for old brushes holds the bristles together and prevents them from splaying outward after cleaning. Make it by folding a sheet of stiff plastic to fit the brush and stapling the side. Place it on the brush by slipping it over the handle.

When you run out of vases for large flowers, you can make extra ones in a hurry by washing the labels off fruit juice cans and perforating the tops with a beer-can opener. To doll them up, give them a coat of enamel or cover them with wallpaper.

What you should know about epoxy paints

Epoxy paints are ideal for beautifying and sealing porous brick and concrete walls, producing a glazed coating which simulates the finish on ceramic tile

Excellent for floors too, the intermixed coating is thinned up to 10 percent for ease of roller and brush application. The primer coat is thinned even more

estimator, paint: see house paints
etching: see sandblasting
etchings: see printing press

■ LOOKING FOR a concrete paint that defies teenage wear? Sounds like a large order but maybe you haven't heard of the new epoxy paints. They're now made to order for rugged wear areas.

Unlike conventional paints, epoxy coatings cure (through catalyzing action) with a "chemical graft" which produces a tenacious bond to practically any surface. They resist alkali and acids better than other hard coatings. It takes a lot to chip and peel them, and they can take a beating when it comes to abrasion. They go on like any paint, produce a finish that looks like glazed tile and come in a host of decorator colors.

Where can one use these miracle paints? Almost anywhere. You can redo an old ceramic-tile kitchen or bath in a whole new color. You can use them to add a tough wearing surface to a basement or garage floor. Their water-resistance properties make them ideal for painting laundry tubs, basement walls and swimming pools. You can use them to give a lasting coating to boat hulls of all kinds.

Epoxies are a two-component coating, consisting of a pigmented base and a hardener, which are intermixed and allowed to stand for 60 min. before applying. However, since the pot life is only 8 hours, leftovers cannot be saved and reused. You mix only what you think you'll need for each coat, making sure you'll have enough, yet not be left with too much to throw away. You can apply the mix with brush, roller or spray gun. Nylon brushes are recommended, as are short-nap mohair rollers, and cleaning and thinning are done with a special epoxy solvent. For fairly small jobs, such as refinishing kitchen appliances, you can now buy epoxy enamel in convenient spray cans, ready to use direct from the can.

You can only apply epoxies at temperatures above 60 deg. F., and it is essential that such temperatures be maintained for a period of at least 72 hrs. after application. This means that paint jobs in unheated areas must be done during warm weather and at a time of year when there is little likelihood of an overnight drop in temperature.

While epoxies dry dust-free in 1 hr. and may be recoated the next day, the final coat requires a much longer curing time than conventional paints. It is recommended that you allow one full week for maximum cure at 70 deg. F. before "moving in" on a floor and giving it hard wear.

In making a test application of a brand we chose an unpainted garage floor mainly because of its poor, porous condition and because we

wanted to see for ourselves the resistance of the coating to oil, grease and salt drippings from a car. We applied three coats (with a roller) in three successive days, thinning the first with an equal amount of thinner as recommended to assure deep penetration of the porous concrete. The work was done late in the fall and we experienced an overnight drop in the temperature after applying the third coat. This retarded the curing and caused the coating to remain slightly tacky under foot for several days. However, it made clear the importance of avoiding low temperatures during and after application.

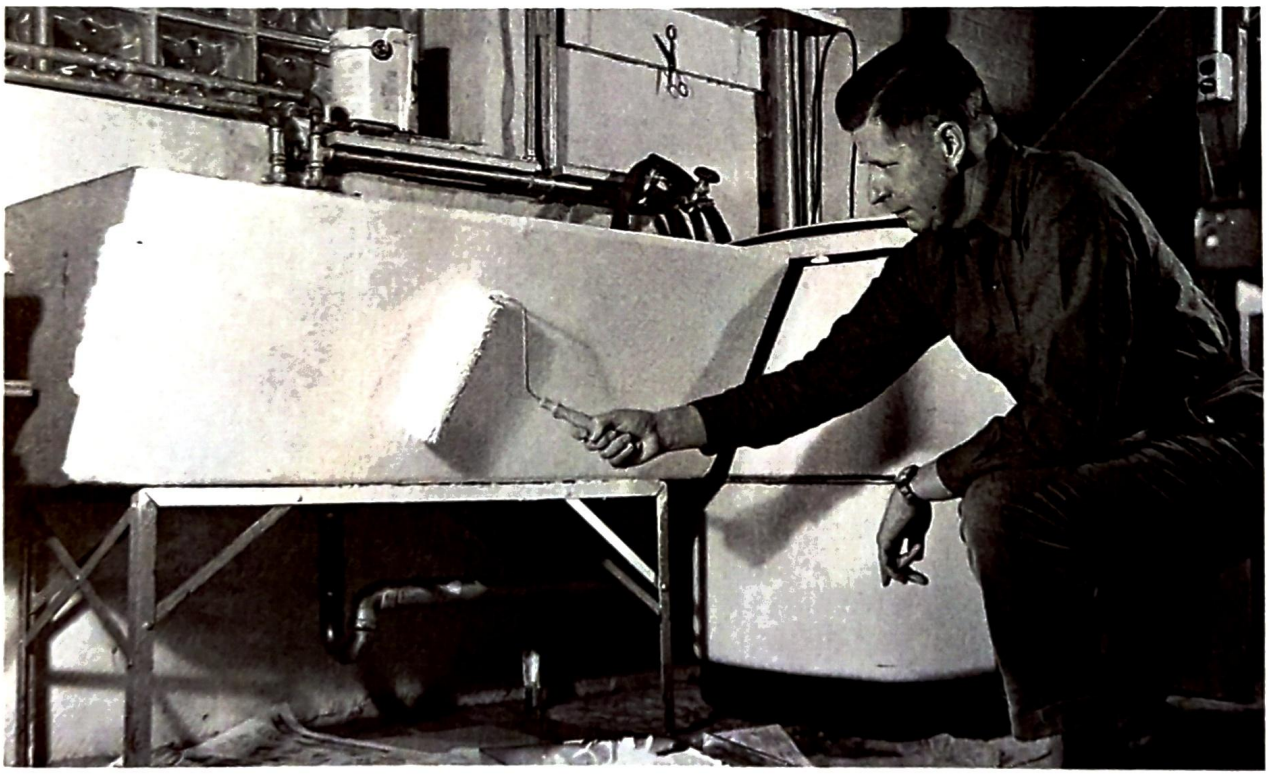
In making performance tests of the finished floor, we found that oil, grease and road salt wiped up without a trace and that the coating did a fine job of sealing the concrete, making it waterproof.

Aside from the long wait for epoxies to cure, which could prove inconvenient in some instances, our main beef was their potent, lingering odor. In closed areas, it is most essential that forced-air ventilation be used to speed the evaporation of the strong solvents. As for a tile-like finish: our test paint produced a glass-smooth surface which bridged the pores and voids with a continuous film and added decorative beauty to an otherwise drab concrete floor.

See also: brushes, paint; house paints; painting; spray painting.

The paint is a two-component mixture, the epoxy color being added to a hardener (below), then mixed thoroughly and left to stand 60 min. before application. When intermixing colors for special shades, thorough mixing of the colors themselves is just as important as the final mixing of the colors with the hardener. Haphazard mixing can result in uneven overall color when the paint is applied and cured

A concrete laundry tub takes on a "porcelain" finish when it is coated with epoxy paint. Use a roller, as shown



ROWING MACHINE

BELT MASSAGER

HEALTH BIKE

ABDOMINAL BOARD

exhaust system, auto: see mufflers, auto
experiments: see electronics; tesla coil; thermopile
extension ladders: see ladders
extension speakers: see high fidelity
exterior paints: see house paints; painting
exterior walls: see sheathing; siding

Build a home fitness gym

By MANLY BANISTER

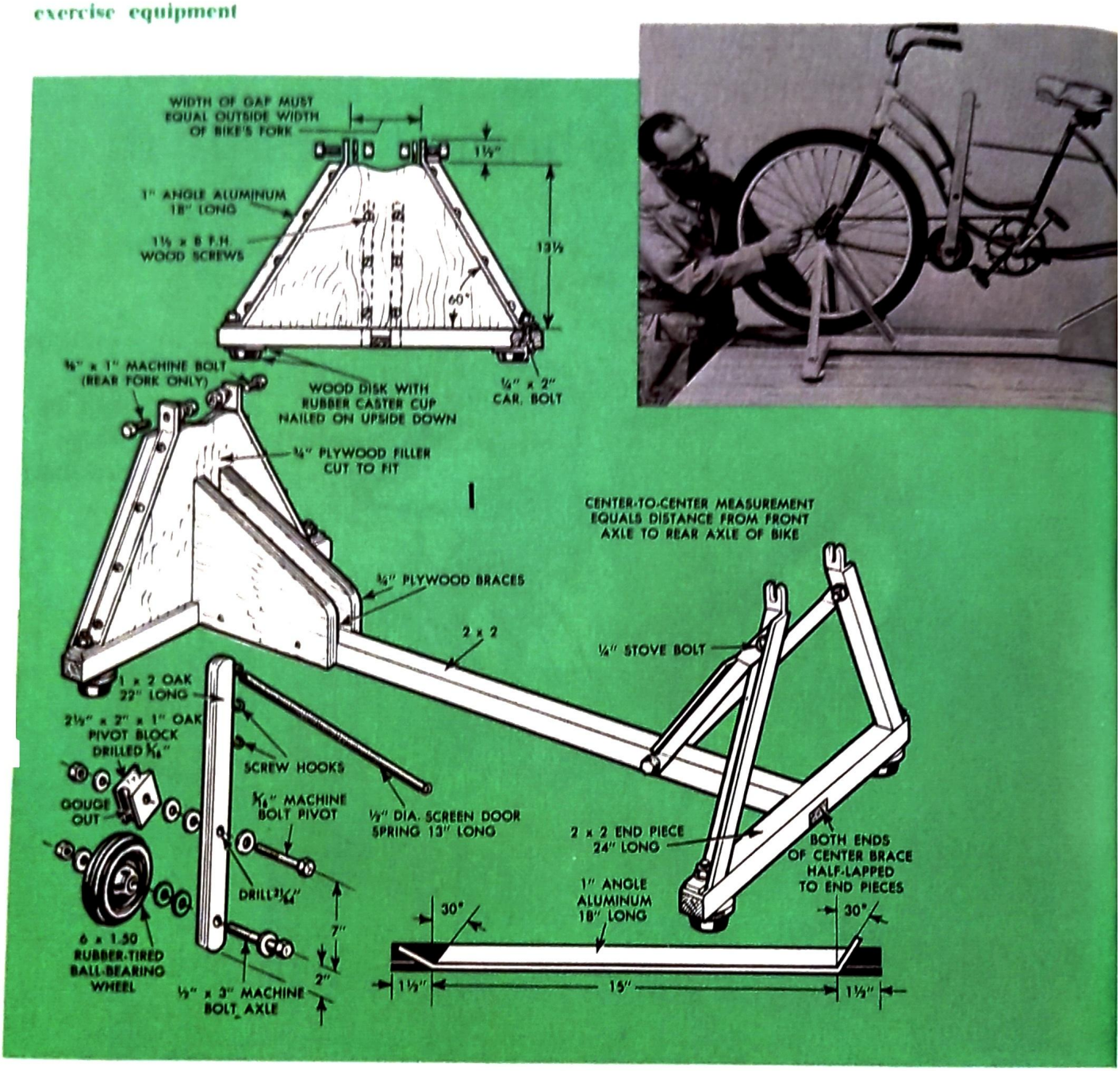
Daily workouts on these five homemade exercising machines will keep the entire family in good shape and ready for anything

MUSCLES FLABBY? Waistline bulging? Tried all the new diets as they came out, only to find that none of them deflated the spare tire permanently? If so, decide now to have your own physical fitness gym by making this low-cost health-building equipment yourself.

You'll soon find that a few minutes each day spent in working out on any one of these body conditioners—the bike, the rowing machine, the belt massager, or the abdominal board—will give you a trim and healthy figure from head to toe. Most important, you'll find those diets that didn't work before *will* work when you combine them with a little healthy exercise.

And there's another plus factor, too. The whole family can enjoy your gym, and there's enough equipment so everyone can get into the act at the same time, whether building up for the football team or trimming down to meet the demands of a new swim suit.

The bike exerciser is the first project. With a bike exerciser you can literally pedal your way to health. A most beneficial exercise, cycling helps to firm and condition the body from the hips down. Here you can ride rain or shine in


WIDTH OF GAP MUST EQUAL OUTSIDE WIDTH OF BIKE'S FORK
1½"
1" ANGLE ALUMINUM 18" LONG
1½ x 8 F.H. WOOD SCREWS
13½
60°
⅜" x 1" MACHINE BOLT (REAR FORK ONLY)
WOOD DISK WITH RUBBER CASTER CUP NAILED ON UPSIDE DOWN
¼" x 2" CAR. BOLT
¾" PLYWOOD FILLER CUT TO FIT
CENTER-TO-CENTER MEASUREMENT EQUALS DISTANCE FROM FRONT AXLE TO REAR AXLE OF BIKE
¾" PLYWOOD BRACES
2 x 2
¼" STOVE BOLT
1 x 2 OAK 22" LONG
2½" x 2" x 1" OAK PIVOT BLOCK DRILLED ⅜"
SCREW HOOKS
GOUGE OUT
⅜" MACHINE BOLT PIVOT
½" DIA. SCREEN DOOR SPRING 13" LONG
2 x 2 END PIECE 24" LONG
BOTH ENDS OF CENTER BRACE HALF-LAPPED TO END PIECES
DRILL 31/64"
1" ANGLE ALUMINUM 18" LONG
30°
30°
7"
2"
6 x 1.50 RUBBER-TIRED BALL-BEARING WHEEL
½" x 3" MACHINE BOLT AXLE
1½"
15"
1½"

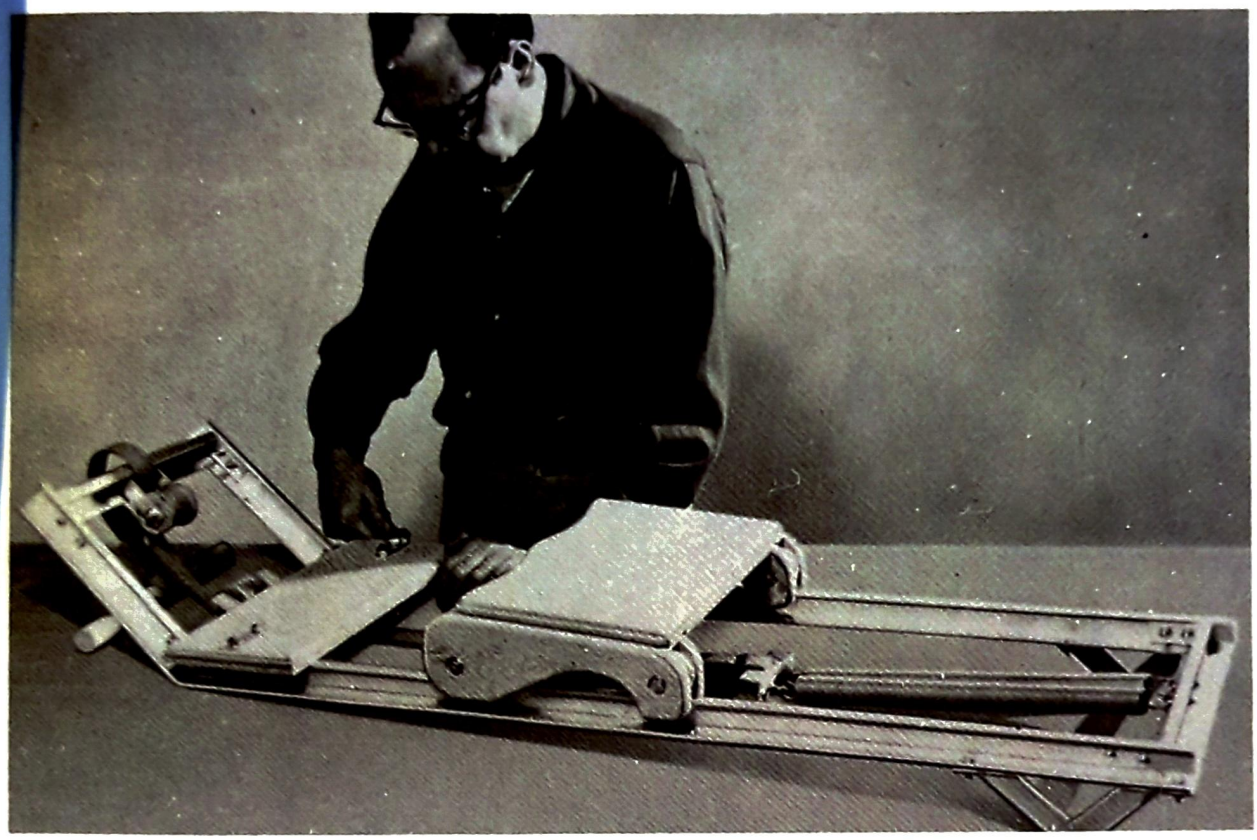
your home on a stationary exerciser built from a discarded bike.

Your first step is to scout around for a standard 26-in. bicycle. Either a boy's or girl's bike will do (I happened to have a girl's bike) although the latter has the advantage of being somewhat easier for all members of the family to get on. You don't need the whole bike, so turn it over on its handlebars and remove both wheels, fenders, and the chain. The rear wheel is transferred to the front fork. In order to do this, you will have to enlarge the axle slots, which I found easy to do with a file.

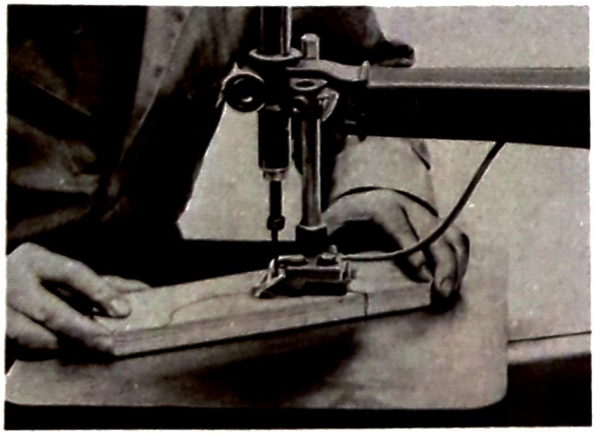
Since the original chain will now be too short, you will have to lengthen it by adding a second chain. This is done by taking both chains apart at their connecting links, then rejoining them in one length.

The new longer chain is placed around the sprockets, measured for length, cut and finally made into an endless chain with a second connecting link. As there is no reason to steer the bike, the front fork is locked in a straight-ahead position by drilling a No. 7 hole through both the fork and the inner handlebar shaft and tapping the hole with a ¼-20 tap. A ¼-20 capscrew holds the front fork rigidly in line with the frame. This is all you have to do to the bike itself.

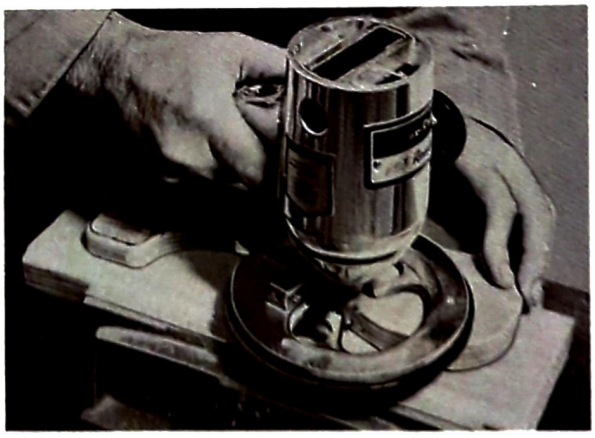
Construction of the supporting base is clearly shown in Fig. 1, along with the friction-wheel assembly. The latter is nothing more than a rubber-tired, ball-bearing wheel bolted to a 1 x 2 oak lever which in turn is pivoted to make the attached wheel bear against the front-wheel tire. Three screw hooks in the lever and a screen-door spring attached to the bike frame at the seat permit varying the tension on the friction wheel. The lower hook provides easy pedaling, the middle hook makes pumping a little tougher and the upper hook makes you feel like you're pedaling uphill. In the case of a girl's bike, the lever is pivoted to a hardwood block so shaped to wedge securely between the double tubular frame. In the case of a boy's bike, pivoting of the lever will perhaps mean drilling a hole through the frame at this point. The actual center-to-center measurement from the front axle to the rear axle of the bike determines the over-all length of the sup-



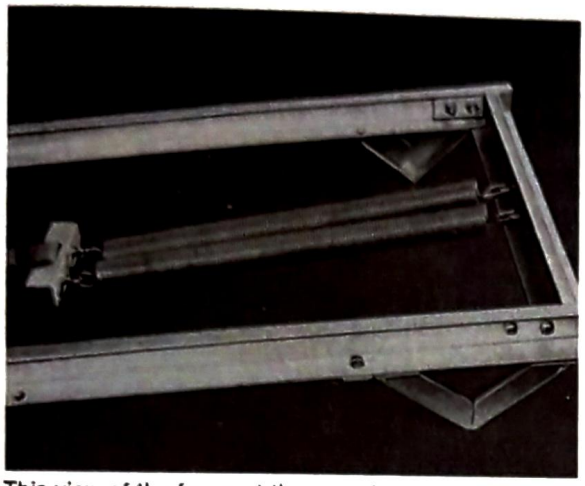
Finish the rowing machine by bolting the footboard to the rails. The seat rides on skate wheels



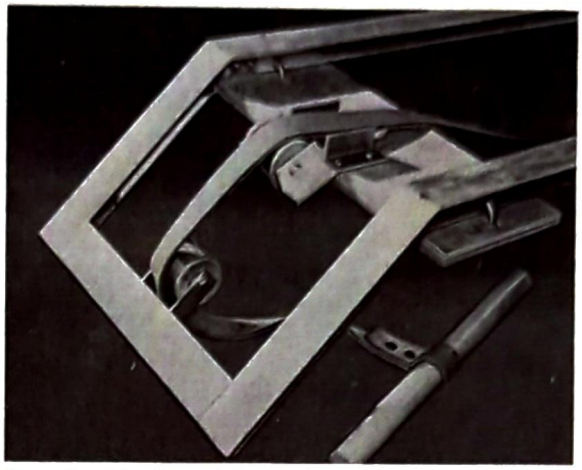
Side members of the rowing seat are jigsawed to shape, then shaped to relieve all sharp edges



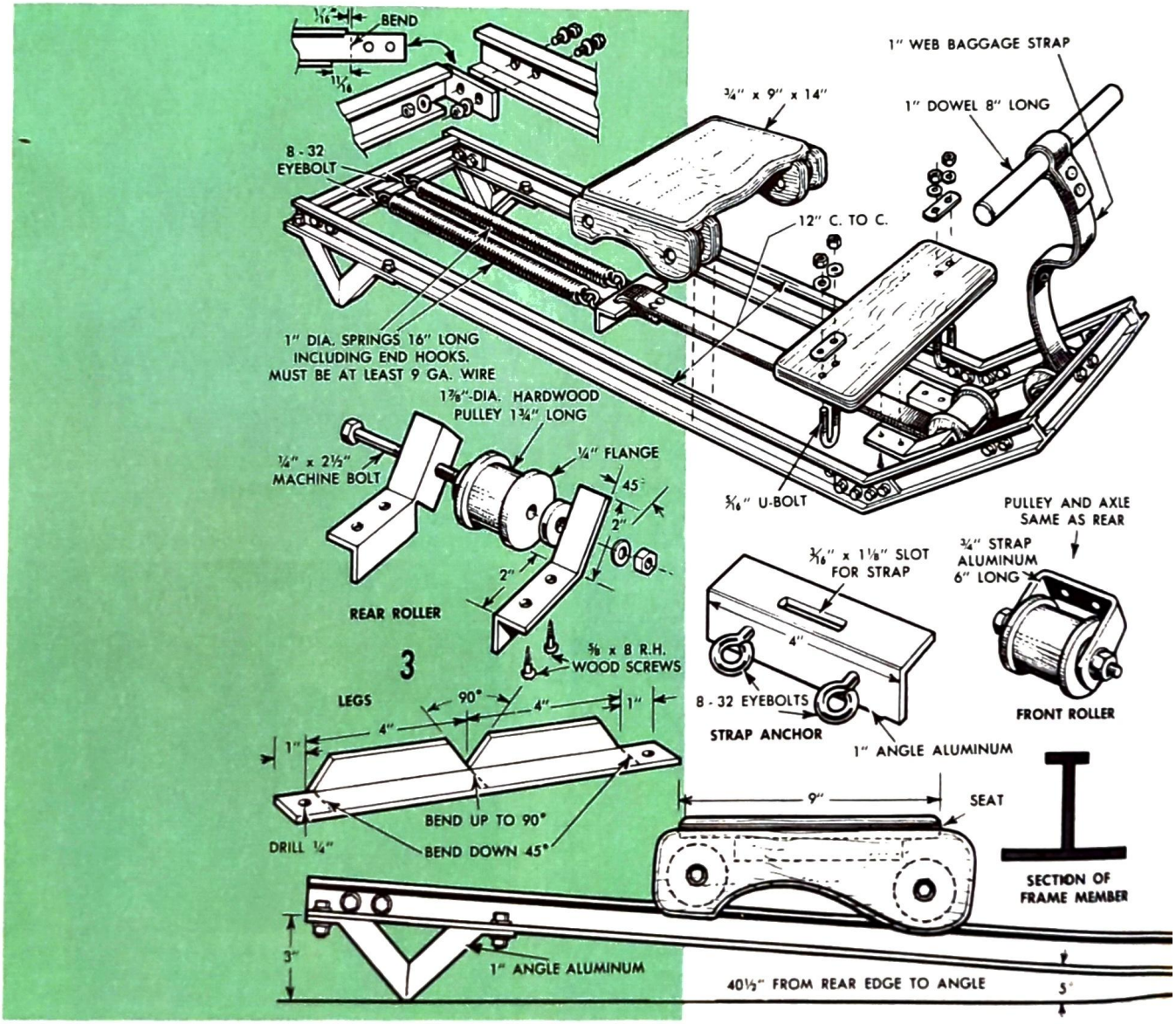
All four side members extend below the rails to keep the seat from coming off the track as it rolls

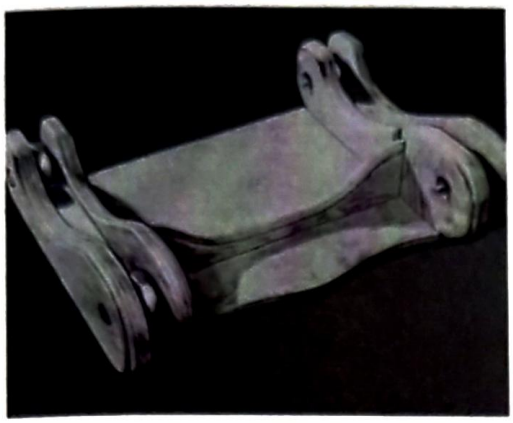


This view of the frame at the rear shows how the twin coil springs are attached to the pull strap



An underside view of the rowing machine shows the web strap doubled at the front to minimize stretching

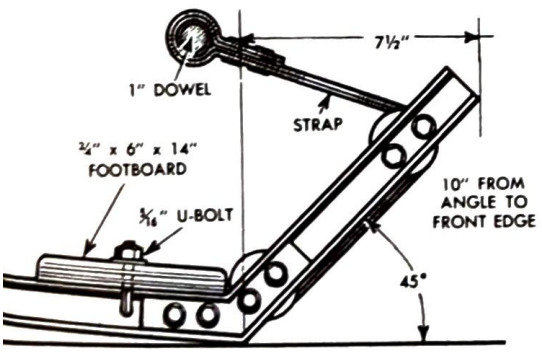


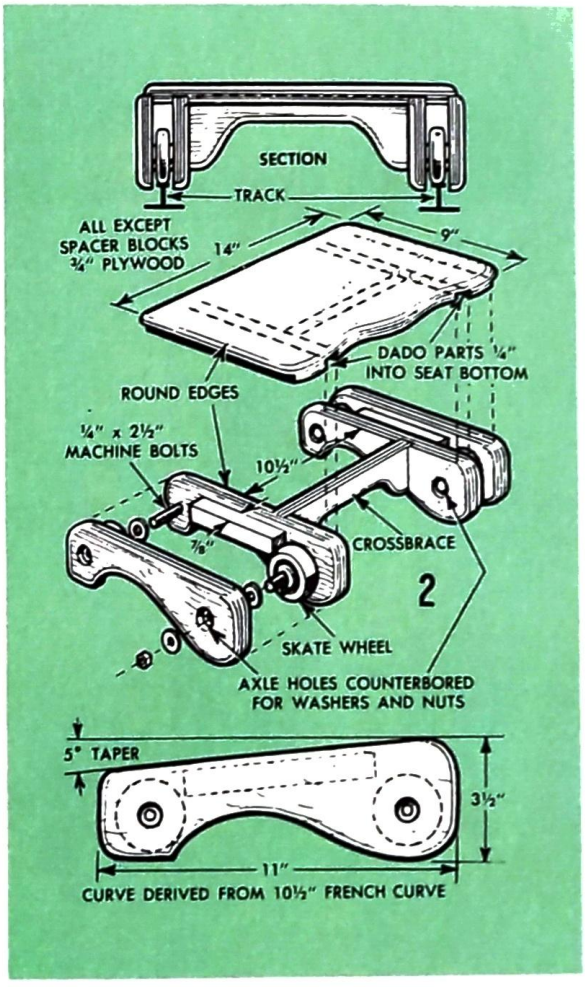


Underside of seat shows skate wheels between the dual sides

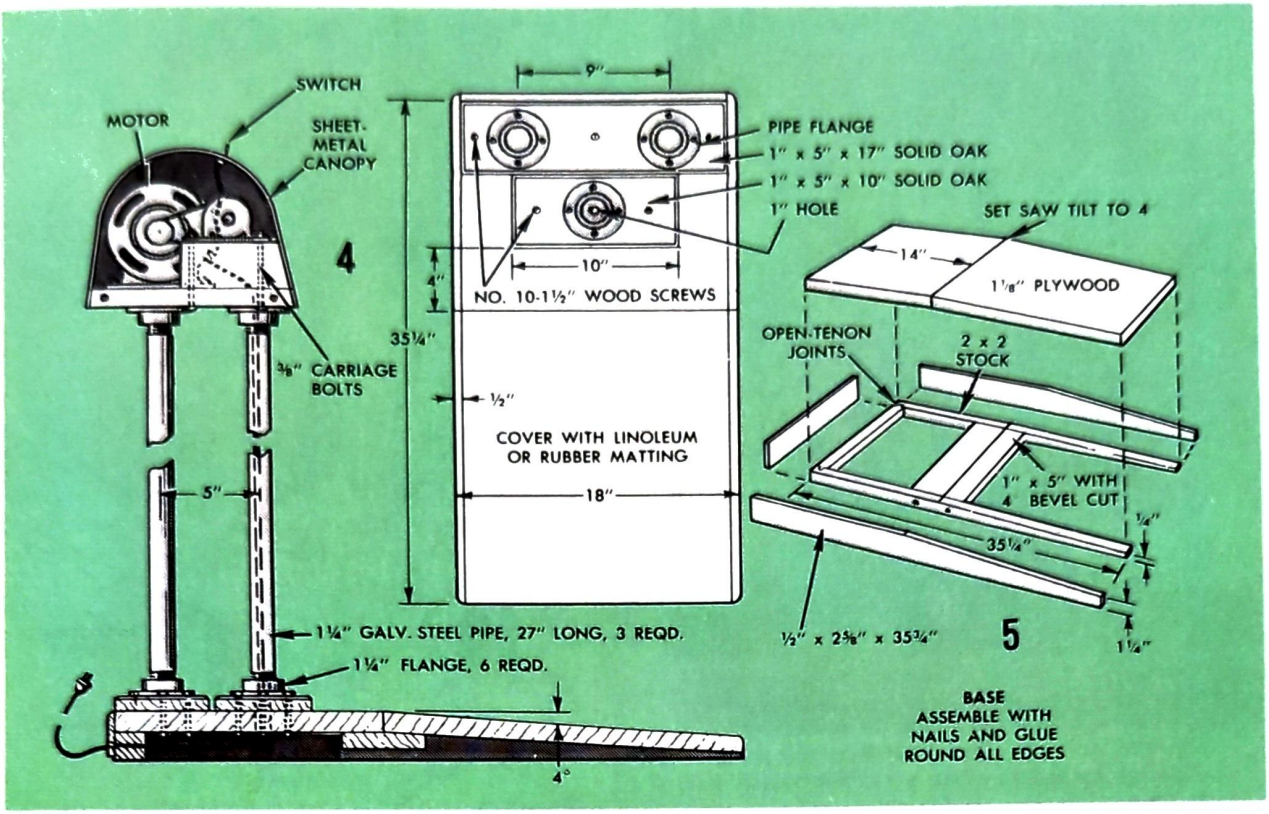
porting base. The length and actual shape of the aluminum members which brace the two front wheel supports are found by trial in bolting and bending the members to fit. The arm of the coaster brake is anchored to the fork with the same clip originally used at the rear. This completes your bike exerciser. You'll find five minutes a day of steady pedaling will develop the thighs and calves and take the creak out of middle-age knees. By pedaling in your stocking feet you'll get the benefit of massaging the arches and balls of the feet in bearing on the pedals.

The rowing machine is a popular exerciser that simulates pulling on the oars of a rowboat. The seat, which rides free of the mechanism, rolls back and forth on the rails as a pull is exerted on





All sharp edges of the belt-massager platform should be rounded to avoid slivers, then sanded smooth and finished with furniture varnish

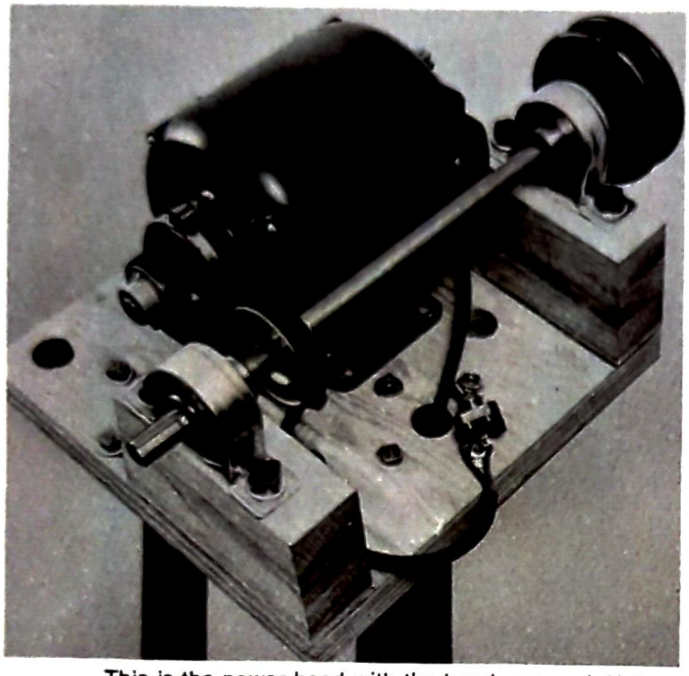


two heavy coil springs attached to the rear of the frame. First study the construction details in Figs. 2 and 3. The inclined rails can be made of anything handy, even hardwood. I made mine from salvaged aluminum extrusion having a T-shape section. Aluminum angle could be used equally as well. Each spring will extend 16 in. which provides a maximum pull of 40 pounds. Along with friction of the rollers a total pull of 90 pounds or more is exerted on the operator's arms. Screen-door springs are not recommended for the coil springs as they are too light even if several were used. The seat, detailed in Fig. 2, is made of ¾-in. plywood and is fitted with ball-bearing skate wheels positioned between double skirts. Note that the latter extend below the rails to keep the seat on the track. The edges of all the parts should be rounded to avoid slivers.

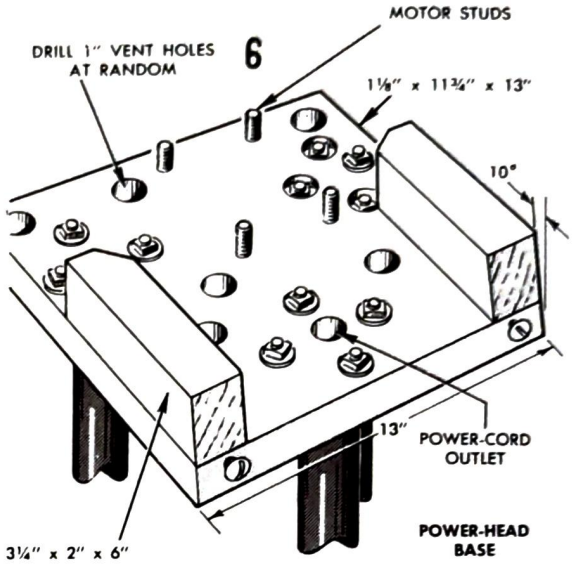
To row, brace the legs straight against the footboard and with the seat pushed all the way back, grip the strap handle and pull it toward you, at the same time bending the knees and letting the seat roll forward. At the completion of the full stroke, release the spring tension slowly, at the same time straightening the legs and pushing the seat back to its original position. Workouts of just a few minutes each day go a long way in strengthening leg muscles, reducing the hips and thighs and flattening the stomach.

Your family fitness gym won't be complete without the old standby—the belt massager. A ten-minute workout after a hard day at the office will make you feel like a new man, completely relaxed. Tired muscles will give way to its soothing massaging action and before long you'll wind up with a trimmer and healthier figure.

Like the bike exerciser and the rowing machine, the belt massager is made of common, easily obtained parts. The important thing in a belt massager is sturdiness. It has to be heavy enough to stay put. The machine in our gym weighs about 80 lbs., operates quietly, without vibration. Start by making the platform detailed in Fig. 5. The top of it is 1⅛-in. plywood. If this is difficult to obtain, glue and clamp a ⅜ and a ¾-in. thickness together. Cut the plywood to its over-all size, 17 x 34¼ in., and then cut a 14-in. piece from one end. Tilt your saw 4 deg. and take a shaving cut from the end of the larger piece. The two-piece top is supported on three sides by 2 x 2s which likewise are tapered 4 deg. and center braced with a 1 x 5-in. member. The latter is beveled across the leading edge to match the slant of the tapered side rails. Use glue and screws to rigidly assemble the 2 x 2s, the cross brace and the plywood top, driving the screws

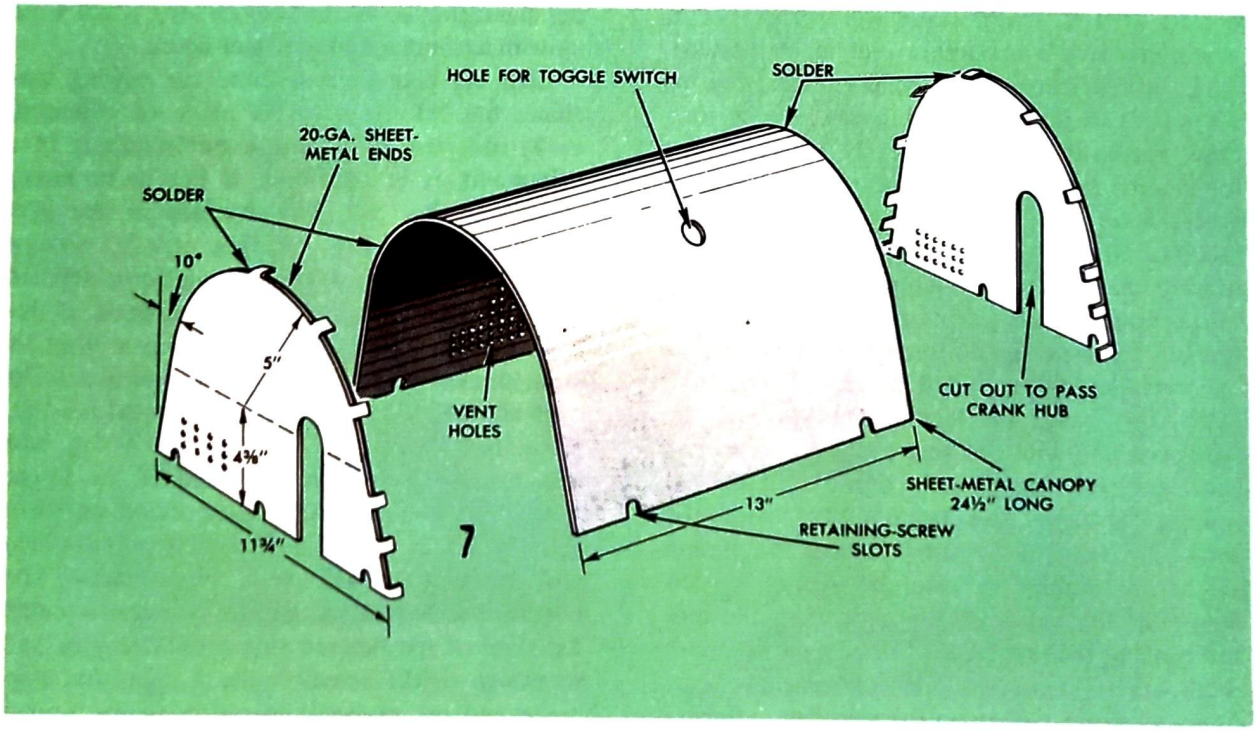


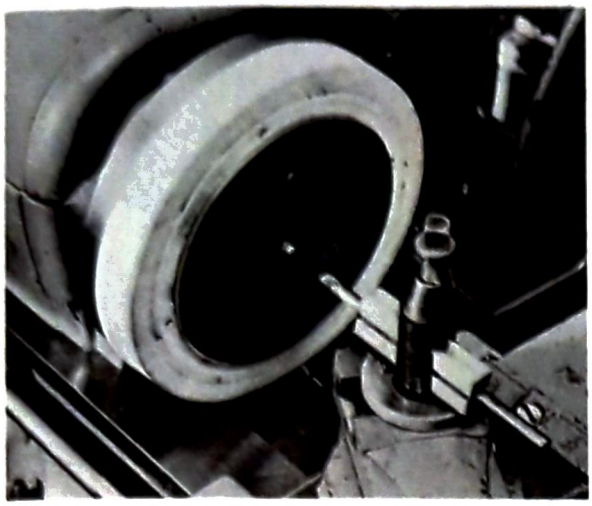
This is the power head with the hood removed. Note how the motor cord runs through pipe pedestal



in the latter up from the bottom. Finally, glue a ½-in.-thick facing to three sides of the base, keeping it even with the top of the plywood. Note that the facing does not rest on the floor. Round all edges and corners and sand smooth. Bore a hole through the rear of the platform for a motor cord.

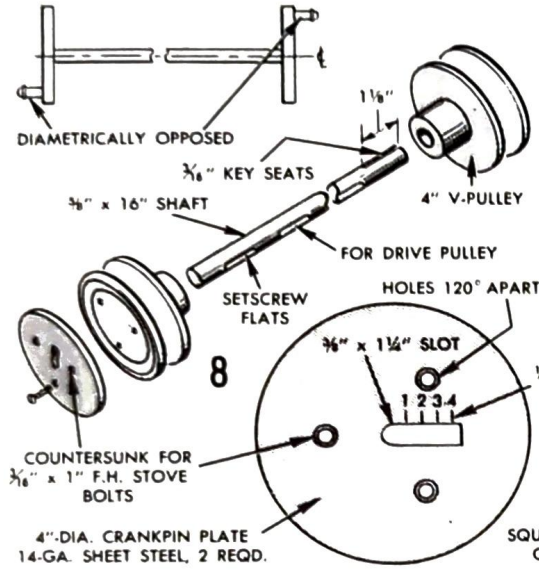
The motor pedestal consists of three 27-in. lengths of 1¼-in. steel pipe fitted with heavy-duty flanges. All three pipes are cut exactly the same length and threaded farther than normal to let

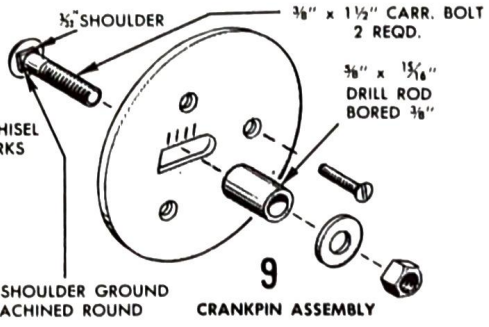




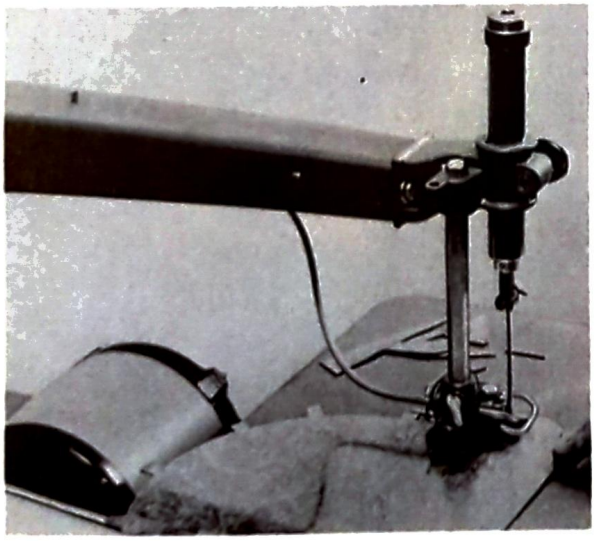
Crankplates which bolt to the face of V-pulleys are screwed to the faceplate wood facing and turned true

With slot aligned with the pulley keyway, the crankplate is clamped to the pulley and holes are drilled

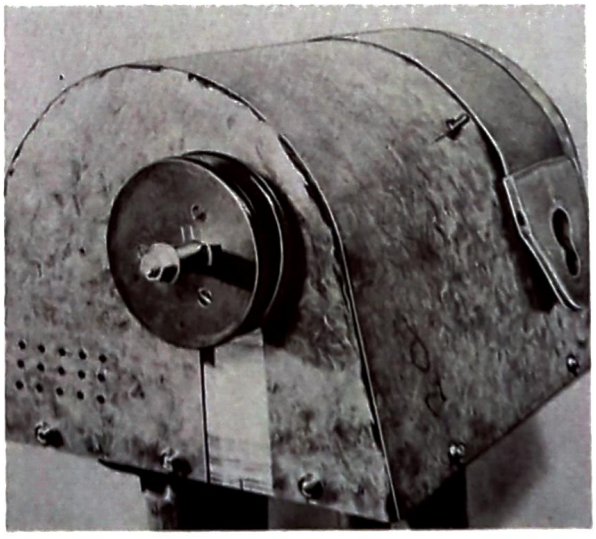


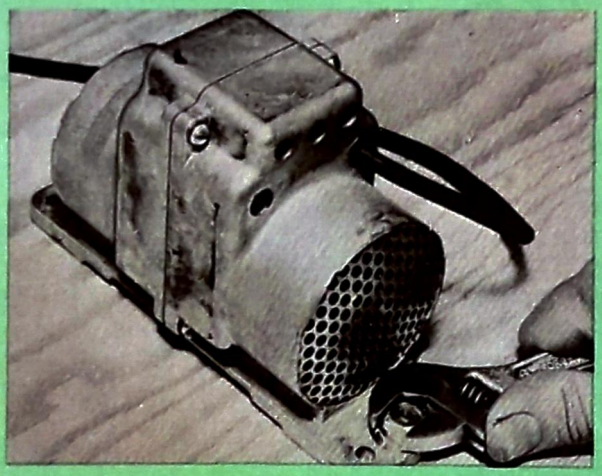

5/32" SHOULDER
3/8" x 1½" CARR. BOLT 2 REQD.
3/8" x 15/16" DRILL ROD BORED 3/8"
SQUARE SHOULDER GROUND OR MACHINED ROUND
9
CRANKPIN ASSEMBLY

The end covers of the hood are cut out with a jigsaw fitted with a metal-cutting blade

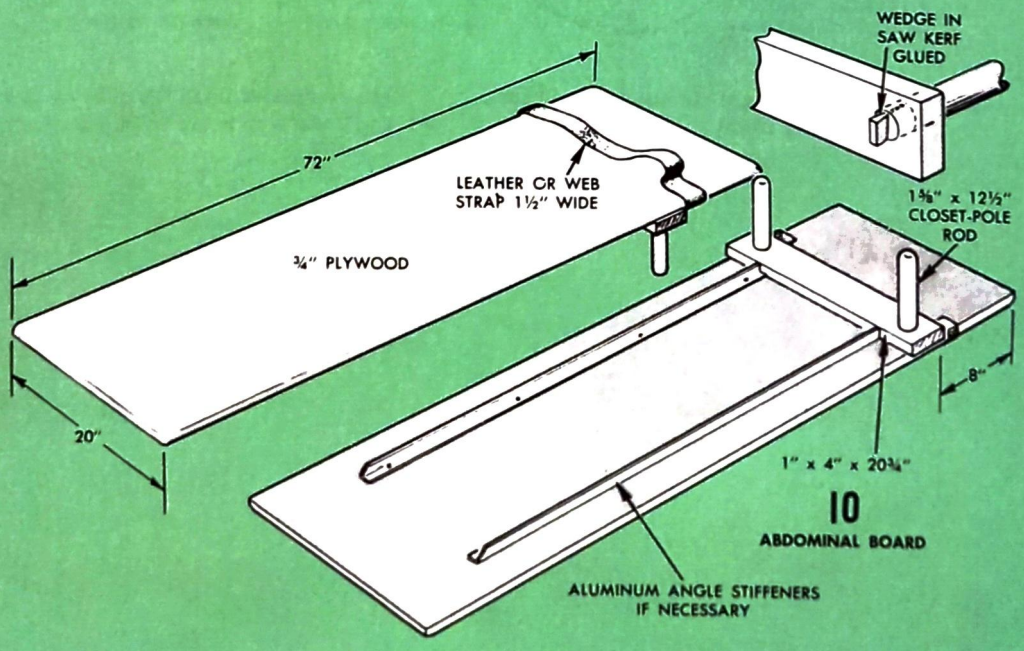


The completed hood fits over the crank heads at the ends. Machine takes 64-in. massaging belt





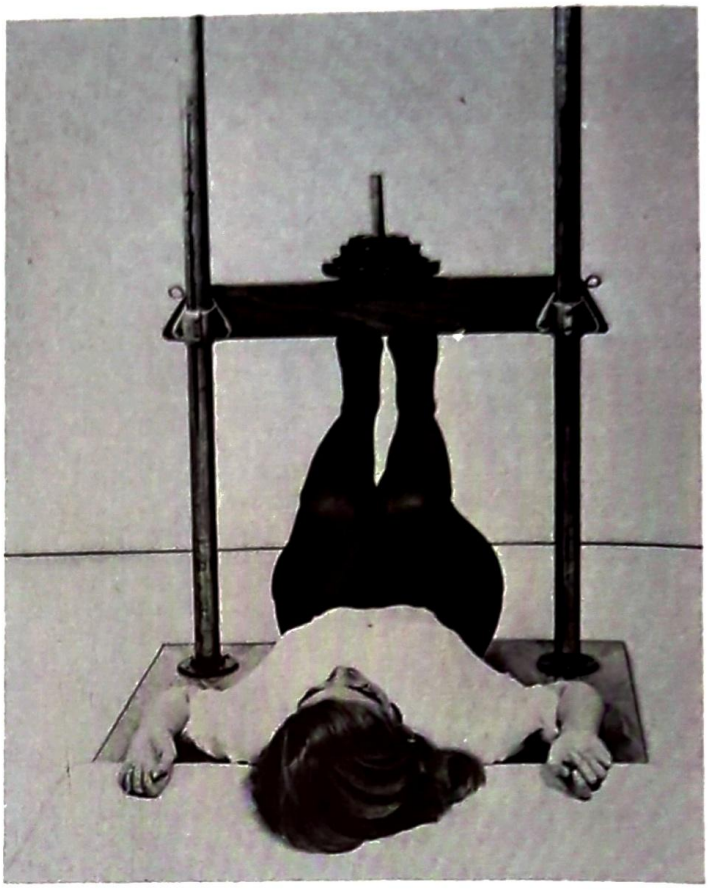
The vibrator motor is bolted to the bottom of the abdominal board. Board's motion eases fatigue and adds pep like nothing else can



10
ABDOMINAL BOARD

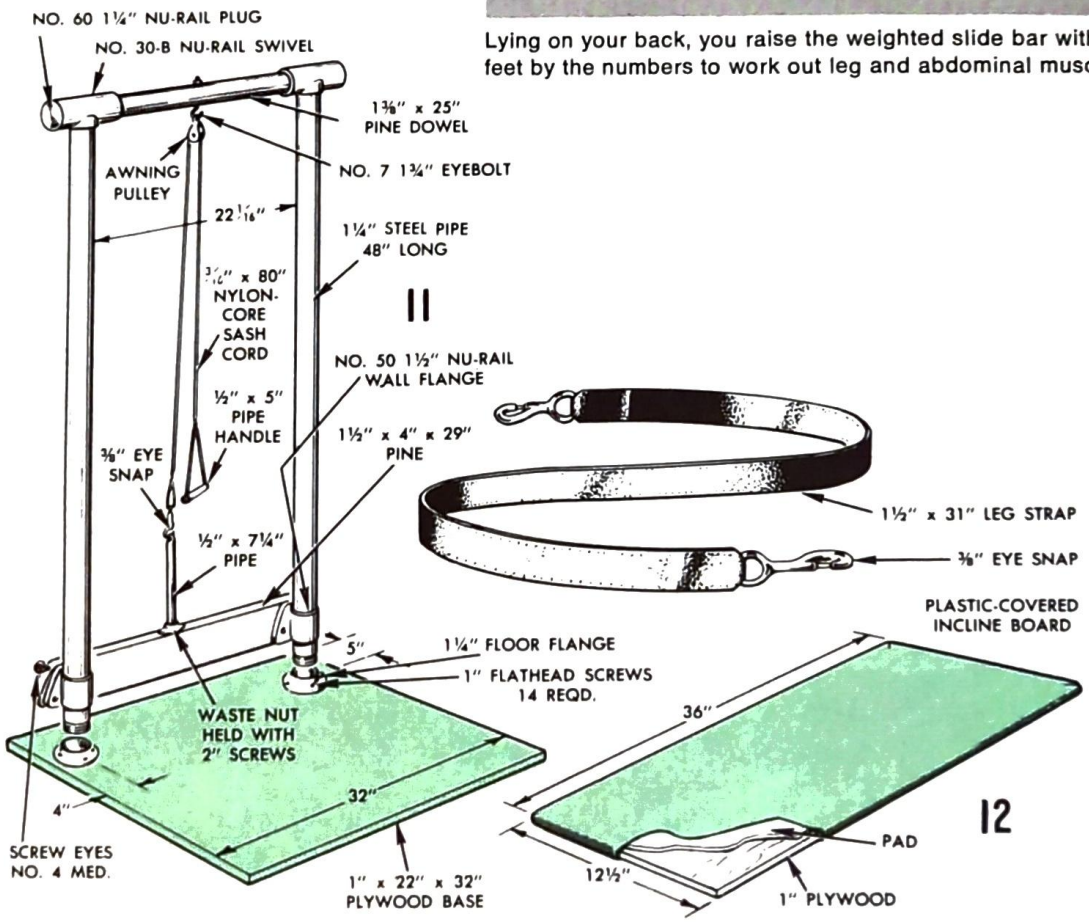
the pipes seat deep in the flanges and be even with the bottom. The lower flanges are solidly anchored to 1-in. oak pads glued and screwed to the rear of the platform as shown in the plan view, Fig. 4. Note that the two rear flanges are located 9 in. center to center. The third flange is centered between the two and 5 in. forward, center to center. All three flanges are anchored securely with ¼ x 3-in. flathead stove bolts which pass through both the oak pads and the plywood. Use lock washers under the nuts. Bolts cannot be used in the rear holes of the rear flanges because of the 2 x 2 member. Husky wood screws

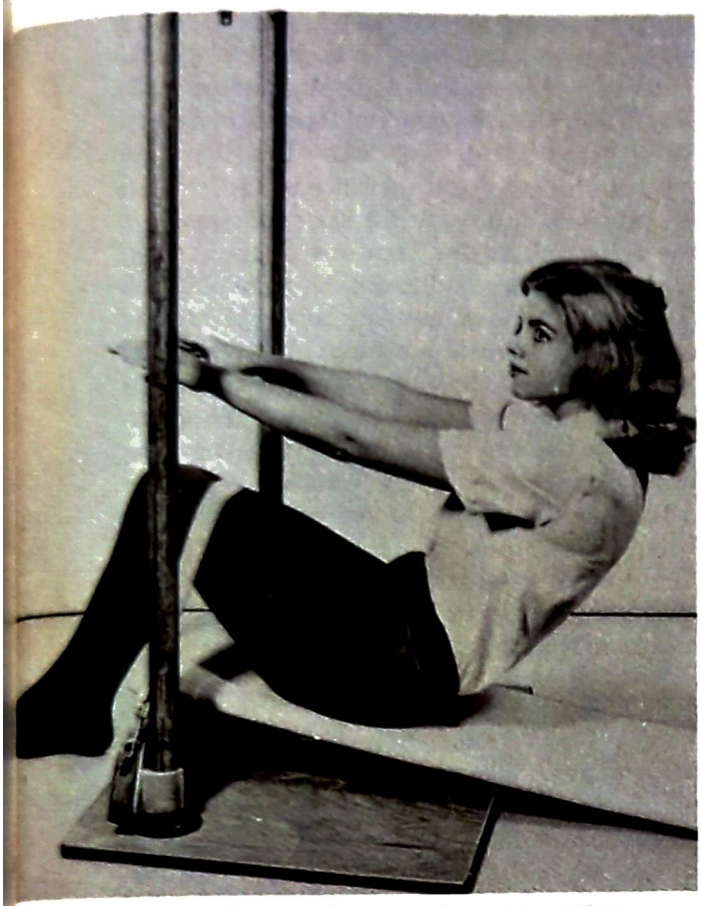
Do leg and hip exercises from a standing position, raising weights with the foot by the numbers



Lying on your back, you raise the weighted slide bar with your feet by the numbers to work out leg and abdominal muscles

build a home fitness gym, continued





Sit-ups to flatten waist are performed by sitting on the inclined board with the knees held by a strap

are used here instead. Note that the front flange is mounted over a 1-in. hole drilled through the platform which permits the power cord to pass up through the pipe.

Fig. 6 details the wooden motor platform of the power head, and the photo at the left of Fig. 6 shows how the motor is belted to a crankshaft turning in pillow-block bearings. Any used ¼-hp. (1750 r.p.m.) washing-machine motor will do and it in turn will determine the over-all size of the motor platform. Like the lower platform, the motor platform is made of 1⅛-in. plywood. After seeing that the flanges on the upper ends of the pipe columns are all turned down to precisely the same level, place the motor platform in position on the flanges and mark the flange bolt holes. Note in Fig. 6 that holes which fall under the motor base are counterbored on the top side so as not to interfere. Bolt holes for anchoring the motor, vent holes and a hole for the power cord are all made in the wooden base before bolting it to the flanges. Oak blocks for the pillow-block bearings are added next. Holes for mounting the bearings are drilled all the way through the motor platform and ⅜-in. carriage bolts are used to anchor all three, the bearings, oak blocks and platform at one time.

The crankshaft, detailed in Fig. 8, is a length of ⅝-in. steel shafting 16 in. long. To spot the pulley-setscrew flats on the shaft, place the shaft temporarily in the bearings and at the same time slip a 2½-in. V-pulley and belt on the shaft. Place a 1½-in. V-pulley on the motor. A center-to-center spacing of 4¼ in. between the motor shaft and the crankshaft will permit a 15-in. V-belt to be used. With the same amount of shaft extending at each bearing, align the shaft pulley with the motor pulley and turn down the setscrew in the shaft pulley hard so it will mark the shaft. Do the same thing with the bearing collars. Now remove the shaft and file flats on the shaft at each mark.

The crankheads, or pitman disks, at the outer ends of the shaft are improvised from 4-in. pressed-steel V-pulleys designed for ⅝-in. belts. These generally are milled with keyways as well as being fitted with setscrews, and it is recommended that keyways be cut in the ends of the crankshaft. However, if you have no means of milling keyways, flats can be filed on the shaft as before. In either case, the important thing to note is that they should be diametrically opposed.

Crankplates, Fig. 9, come next. These are disks of 14-ga. steel or ⅛-in. brass which are turned to the same diameter as the pressed-steel pulleys and then drilled and bolted to them. To make the crankplates, first saw them out roughly on a jigsaw, then turn to the proper diameter. Bore a ⅜-in. hole dead center through the disk and lay out and drill three 3/16-in. holes 120 deg. apart on a 1-in. radius. Countersink the latter holes for 1-in. flathead stove bolts. Now form the center hole into a ⅜ x 1¼-in. adjustment slot. This can be done on the jigsaw or by drilling a series of overlapping holes and working out the waste with a file.

attaching crankplates

The holes in the crankplates are used as a guide in spotting and drilling registering holes through the faces of the pulleys. To do this, align the slot in the disk with the keyway in the pulley and clamp both together. Then, with the pulley supported over an open drill-press vise, carefully drill each hole. By aligning the slots with the keyways, the crankheads will automatically be offset 180 deg. from each other. Before the crankheads can be permanently bolted to the pulleys they must be fitted with crankpins, Fig. 9. These are made from bright-finish ⅜-in. carriage bolts slightly altered by chucking and turning down all

but about 3/32 in. (the thickness of the crankplate) of the square shank. This lets the shouldered bolt head seat securely in the adjustment slot. Sleeves are made by boring 5/8-in. drill rod lengthwise with a 3/8-in. drill bit. A nut and washer draw the crankpins up tight. Chisel marks spaced ¼ in. apart along the adjustment slot and numbered 1, 2, 3 and 4 will serve to vary the stroke of the massage belt from a mild to a vigorous action. In bolting the crankplates to the pulleys draw up the bolts so they draw the disks slightly concave. Use lock washers on the bolts. Polish the crankplates and pins with emery cloth followed by crocus cloth.

A lift-off sheet-metal hood, or canopy, lets you get at the motor and belt by loosening wood screws driven in the edge of the wooden base. Fig. 7 shows how the hood is made, the end covers being laid out on 20-ga. sheet metal. Tabs are left around the top edges; slots are formed along the bottom to slip under the screw heads mentioned; vent holes are drilled as indicated and cutouts are made to clear the ends of the crankshaft. You can cut out the end covers neatly by chucking a metal-cutting blade in your jigsaw. The center part of the hood can be of lighter (26-ga.) sheet metal. Like the end covers, screw slots are formed along the lower edges, a hole is made for a toggle switch and the metal is rolled to the same curvature of the end covers. The covers are soldered to the center section with the tabs placed on the inside. Then the seam is filled on the outside with epoxy mastic. When the latter is filed smooth and the hood painted, the joints will be as neat as can be.

now for a massage

After cementing rubber matting to the platform, your belt massager is completed and ready to try out. The machine is designed for a regular 64-in. commercial belt having conventional leather ends. In using the machine, abdomen, hips and upper thighs are treated in a standing position, facing toward or away from the power head. To massage sore muscles in chest or upper back, sit on a stool placed on the platform. To massage the lower thighs, calves and feet, place the stool alongside the platform. Then detach the belt from the far crankhead and wrap the belt around the calf or foot. Take up the slack by holding the free end and start the motor.

The abdominal board is nothing more than a board inclined at one end on which the person lies on his back, head down and the feet hooked under a strap at the head of the board. Exercising consists of touching the toes with the hands from a sitting position, then lying on the back to a rhythmic count. The easiest of all your equipment to make, Fig. 10 shows how you start off with a plywood board 20 in. wide and 72 in. long. All edges are rounded and sanded smooth. Stiffeners of aluminum angle or 1 x 2 strips are screwed to the underside, a cleat with dowel legs attached is screwed to one end and a leg strap attached. The latter can be of anything handy; a length of web belting is fine. It is tailored to the person by passing it across the ankles while sitting on the board and then securing the ends to the underside with washers and screws. An optional but worthwhile feature of the board is a vibrator motor. This is bolted to the underside of the board with the nuts flush in counterbored holes. Ten minutes spent relaxing stretched out on the abdominal board with the vibrator plugged in will make you feel like you're floating on air.

all around conditioner

Fig. 11 details still another piece of equipment for your home fitness gym. This simple exerciser makes use of weights to condition the body from a standing, sitting or lying position. As shown, it features a slide bar which is weighed with barbell disks and used as a leg exerciser from a prone position by raising the bar with the feet. Weights at the end of a pulley-and-cord arrangement provide beneficial leg, back and arm exercises from both a standing and sitting position. And when equipped with a padded board elevated at one end by resting it on the slide bar, the exerciser has its own abdominal board. Fence fittings called Nu-Rail wall flanges are attached to the ends of the slide bar and slip over regular 1¼-in. pipe standards which screw into common pipe flanges attached securely to a plywood base. A length of wooden closet pole with an eyebolt through it to hold an awning pulley is supported at the top by fence parts called swivels. A spindle to hold the weights on the slide bar consists of a waste nut and a pipe nipple. A second spindle which is used free of the bar consists of the same parts but with the end of the nipple flattened and drilled for attaching to a length of cord fitted with a snap. The cord is passed over the pulley and a hand and foot yoke are formed at the end by passing the cord through a 5-in. section of ½-in. pipe. Screweyes at each end of the slide bar permit a knee strap to be snapped to them for use with the abdominal board.

See also: archery; bicycles; swimming pools; water skiing.

Hang anything on any wall

BY ALFRED W. LEES

Whether you're mounting a pin-up lamp or a suspended bar—on a frame wall or on solid masonry—you must choose the type and size of fastener that fits the job

MORE AND MORE, the walls of our homes are being put to work. Today we hang dozens of things *from* walls—including buffets—and new fasteners have been developed for specific jobs.

Yet many homeowners aren't even familiar with the old standbys, such as toggle and "Molly" bolts. A comprehensive "selector chart" is needed on all wall fasteners, old and new, and on the next five pages you'll find just that.

The first thing to consider, in choosing a fastener, is the type of wall it's going into. In most homes, this will be a hollow wall above grade and a poured or block wall in the basement. In hollow walls you want a fastener that passes through the plaster or drywall face (or the wall of cinder block or hollow tile) and spreads out to anchor against the back. In solid walls, you want a fastener that holds by expanding against the sides of the hole you sink it into, whether in concrete, brick or stone.

Two additional considerations determine your choice of fastener: the weight of the fixture you're hanging, and the type of load it presents. A *light* load is under 10 lbs. (picture frames, pin-up lamps, metal soap dishes) while a load of 25 lbs. or more is *heavy*. A *shear* load is one which exerts a straight-down pull (such close-to-the-wall items as mirrors or wall clocks) while *combination* loads exert an outward pull, as well (shelves, cabinets), and require stronger anchorage. *Dead* loads, where the pull is constant, need less anchorage than *shock* loads which must withstand sudden impact or increased weight, and *vibration* loads (such as air conditioners) call for special treatment—usually a fastener that can be retightened.

We've listed those "Load in Concrete" figures only to provide a comparison between types of fasteners; as quoted by the manufacturers, these figures represent test loads in "first-quality" concrete—not safe working loads. The latter are usually calculated at one-fourth test load. When in doubt, use more fasteners or a heavier-duty type. Over-fastening can't hurt.

Except for a couple of driven types listed, fasteners must be set into a drilled hole. A carbide-tipped masonry bit in an electric drill (particularly a variable-speed type) makes fast work of this in plaster, ceramic tile, brick and concrete. Large-diameter masonry anchors, however, call for hand-hammering with a star drill.

To select the right length hollow-wall fastener, you must know the thickness of the surface wall. You can determine this by drilling a small trial hole at the mounting location and inserting a crochet hook or sturdy wire with a hook bent at one end. Catch the hook against the back of the wall and jamb your thumb against the face of the wall. Back the hook out and measure between its lip and your thumbnail. This is the thickness the fastener must penetrate before its anchoring device can function. Where the fastener must pass through the mounting plate you must add that thickness, too.

fat-tire scooter: see scooter

"ALL-PURPOSE" FASTENERS

PLASTIC ANCHOR

NYLON EXPANSION (NYCAM)

NYLON DRIVE ANCHOR

SIZE RANGE AND LOAD CAPACITY

Screw† Size	Anchor # & Length	Holding Power
4, 6, 8	#1, 7/8"	650
10, 12	#2, 1"	850
14, 16	#3, 1½"	1075

†Although most brands come in three sizes, the recommended screw ranges differ. Where screws are not packaged with the anchors, use size recommended on package. Jordan offers a 2½" length for ⅜" lag screws.

One size (about 1" long, requiring a ⅜" hole) serves all applications, comes with 1⅛" self-tapping screw.

Shear load tests: 280 lbs. in cement block, 50 in ⅜" plasterboard.

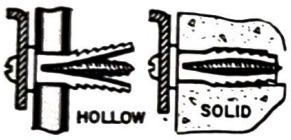
Dia.	Lengths
¼"	¾, 1, 1½"
3/16"	1, 1½"

Both Tap-It (U.S. Expansion Bolt) and Jif-Eze (Jordan) come in choice of head style (round, flat, mushroom) and not all lengths avbl. in all head styles.

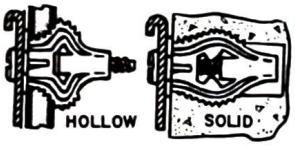
Shear tests: 800 lbs. in solid wall, 365 in hollow.

INSTALLATION PROCEDURES

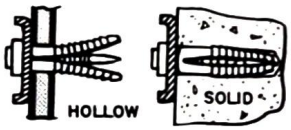
Except for larger sizes, anchors are molded in strips; break one off and force into hole of size recommended on card; insert screw through fixture and drive into anchor.



Drill hole at least 1½" deep, pinch anchor between fingers and tap in place with hammer. Insert screw through fixture and tighten.



Insert fastener through fixture's mounting hole and push into wall hole. Tap nail until its head seats against fastener's.



RECOMMENDED USES

Mounting any item normally held with wood screws—large pictures, mirrors, shelf brackets ,drapery hardware, kitchen and bath accessories, awnings, mailboxes, Peg-Board hang-up panels . . . on concrete, tile, brick and hollow plaster walls.

Mounting any item such as drapery hardware, brackets and fixtures to any type wall: plaster, drywall, brick, marble, concrete, cinder block, stone, or even wood.

Drapery hardware, shelf brackets, mirrors, pipe straps, outlet boxes—anything with mounting hole that will pass anchor — to plaster, brick, stone, tile, concrete, composition or hardboard.

ADVANTAGES OVER OTHER TYPE

Since anchor is rustproof, it's fine for bathroom fixtures, outdoor installations. Small hole means little wall damage. Strips keep supply handy for quick use. Screw can be removed and reinserted.

One type and size of fastener for all light hanging needs. very thin lip lets you mount flush to wall. 1-pc. nylon construction.

Average installation time: 12 seconds, compared with 25 for the simplest wood-screw anchor. Comes with nail ready for tapping.

DISADVANTAGES

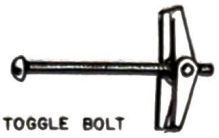
Hole size is critical—anchor must fit snug, and is only as good as the wall material. For light shear loads only. Won't hold against much horizontal pull, especially in crumbly masonry.

Fairly large hole required; not satisfactory in hollow wall more than ⅜" thick, so won't expand behind most plaster walls.

Fixture can't be removed without withdrawing entire anchor, as well. Mounting hole in fixture must be at least 3/16" in dia. White nylon head shows around nail. More expensive than plain plastic anchor.

FOR HOLLOW WALLS ONLY

NEOPRENE SLEEVE (WELL-NUT)



TOGGLE BOLT

EXPANSION BOLT

SIZE RANGE AND LOAD CAPACITY

Bolt Length	Dia.	Load (lbs.)
2,3,4"	⅛"	200
2,3,4,5,6" } †	3/16"	450
3,4,5,6" } †	¼"	925
3,4,5,6"	5/16"	1150
3,4,5,6"	⅜"	1500
4,6,8"	½"	1800

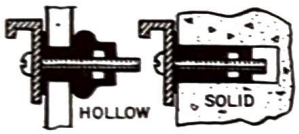
†Some makes have 2½, 3½ & 4½" as well

Size*	Overall Length	For Wall Thickness	Load
XS	¾-7/8"	0 to ¼"	200
MS	1-1½"	1/16 to ½"	to
S	1½-2¼"	⅛" to ¾"	500
L	2-2¾"	⅝" to 1¼"	Difs.
XL	2½-3½"	1¼" to 1¾"	with make

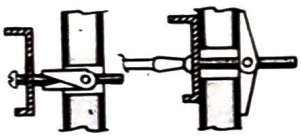
*There is no industry standard so these are compromise listings. Some brands have each length in several diameters

INSTALLATION PROCEDURES

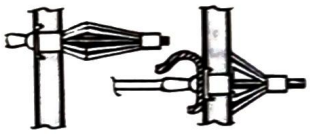
Drill hole same diameter as neoprene shank (in solid wall, drill just deeper than length of screw); push Well-Nut in, up to flange, hold fixture against it while tightening screw through mounting hole. Shank bulges as nut draws up, forms rivethead against back of hollow wall or pressure fit in solid wall.



Insert bolt through fixture and spin the toggle head on several turns. Fold wings and push them through proper size hole in wall. Tighten bolt to draw wings snug against back of wall.



Insert unit in drilled hole, tap to embed cap teeth in wall surface, turn screw to draw split sleeve into "spider" against back of wall; remove screw and reinsert after passing through mounting hole of fixture.



RECOMMENDED USES

Coat hooks, drapery hardware, shelf brackets, bathroom fixtures, electrical equipment, auto accessories and trim, hi-fi speakers on dry wall, tile, glass, marble, masonry, plaster, metal, or wood.

Large hanging cabinets, heavy-duty shelf standards, wall radiators or vent fans, bathroom grip bars.

Mirrors, wall cabinets, lamps and clocks, adjustable shelf brackets, window cornices, shades and blinds, coat hooks.

ADVANTAGES OVER OTHER TYPE

Ideal for mounting hi-fi speakers, window fans, other installations where vibration should be dampened. Creates watertight seal, will plug leaks; insulating quality in electrical installations. Neoprene stays flexible so fastener is removable, reusable.

Simple, immediate-action installation, great strength for combination loads. Alignment of mounting holes with wall holes isn't critical.

Requires smaller hole than toggle, centers bolt precisely. Remains in place for reuse if fixture is removed. Bolt is easily inserted through fixture *after* positioning on wall.

DISADVANTAGES

Standard size not suitable to all situations (hollow walls can only be ⅜ to 9/16" thick). Over-tightening ruins fastener.

Requires large insert hole to pass wings, so bolt "floats", does not position fixture precisely. Mounting plate must be big enough to hide hole. If fixture is removed, wings drop off, are lost in wall (See Variations). Installation awkward where fixture requires several bolts, since all must be inserted through fixture before positioning.

Slower installation (unless special tool is used). Less strength, since smaller bolt and thinner anchor metal is involved. Mounting holes must exactly align with fastener—tricky where several are involved.

MASONRY WALL FASTENERS

FIBER ANCHOR (LEAD CORE)

LEAD SCREW ANCHOR

LAG SCREW SHIELD

SIZE RANGE AND LOAD CAPACITY

Screw Size	Anchor Lengths	Load in Concrete
5-6	⅝, ¾, 1	550
7-8	⅝, ¾, 1, 1¼, 1½, 2	885
9-10	¾, 1, 1¼, 1½, 2	1150
11-12	¾, 1, 1¼, 1½, 2	1525
14	1, 1¼, 1½, 2	1590
16	1, 1½, 2	2150
20	1, 1½, 2	2830
22	2	3500

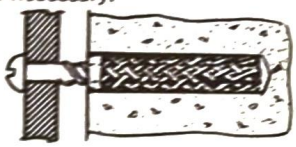
Screw Size	Anchor Lengths	Load in Concrete
6-8	¾, 1, 1½	to 400
10-12-14	1, 1½	to 900
16-18	1, 1½	to 3000
20-22-24	1¾ or 2	1600 up

Screw Size	Shield Lengths	Load in Concrete
¼	1, 1½	450, 600
5/16	1¼, 1¾	800, 1200
⅜	1¾, 2½	1200, 2000
7/16	2¼ only	1650
½	2, 3	2000, 3000
⅝	2 or 2½,* 3½	2500, 3500
¾	2 or 2½, 3½ or 3¾*	3000, 4000

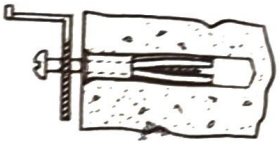
*Long Standard Sizes differ with brands

INSTALLATION PROCEDURES

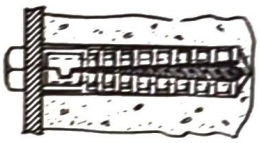
Use drill, plug and screw of same size. Clean hole of loose particles. Insert plug just below surface, drive screw through fixture into lead core. Only threaded section should enter plug, so use proper-length plug, recess in deeper hole if necessary.



Screw length = thickness of mounting plate + length of anchor + ¼". Drill hole ¼" deeper than anchor, set it flush with wall surface, drive screw through fixture.



Drill hole same size as outside dia. of shield. Set in shield flush with or slightly below surface, insert screw through fixture and into shield, which expands as screw enters.



RECOMMENDED USES

Mounting any item you'd normally attach with wood, sheet metal or lag screws (for latter, there are larger sizes than listed)—outlet and fuse boxes, mirrors, bathroom fixtures, fireplace tools, awnings, etc.

Same as fiber anchor.

Mounting any item too heavy for plain screws—especially to a brick wall where hole can be drilled into mortar joint without marring brick.

ADVANTAGES OVER OTHER TYPE

Easy, inexpensive, versatile. Screw may be removed and replaced without affecting anchorage. Once screw is in, plug grips wall firmly.

Flared end prevents loss of fixture through drilled hole in concrete block, etc. also makes it easier to start screw.

Heavy ribs assure powerful gripping action. Choice of long or short for each screw dia. lets you minimize drilling in hard masonry, or use long size for more strength in weak masonry and brick.

DISADVANTAGES

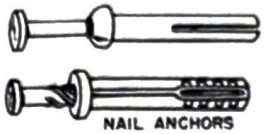
Hole size is more critical than with most fasteners. Holding power depends on strength of wall material; poor in crumbly concrete, plaster.

Size for size, less holding power than fiber anchor; hole in wall must be exact fit.

Requires fairly large masonry bit, greater installation time since screw must be driven with wrench.

MACHINE SCREW ANCHOR

MACHINE BOLT SHIELD



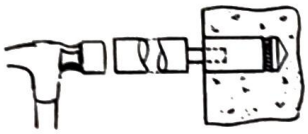
NAIL ANCHORS

Screw Size	Dia. Hole (Inches)	Min. Depth (Inches)	Load in Concrete (Pounds)
6-32	¼	⅜	625
8-32	5/16	½	950
10-24	⅜	⅝	1100
12-24	7/16	¾	1750
¼-20	½	7/8	2275
5/16-18	⅝	1	2850
⅜-16	¾	1¼	3670
7/16-14	7/8	1½	5500
½-13	7/8	1½	7200
⅝-11	1⅛	2	7800
¾-10	1¼	2¼	8300
7/8-9	1½	2¾	10000
1-8	1¾	3½	12000

Bolt Size (Inches)	Shield Lengths* (Inches)	Dia. Hole* (Inches)	Working Loads (Up to:)
¼	1½	½	500
5/16	1½-2	⅝	800
⅜	1½-2⅜	¾	1000
7/16	2-2½	7/8	1000
½	2-2 7/8	7/8	1500
⅝	2½-3¼	1-1⅛	2000
¾	3½-4	1¼-1⅜	2000
7/8	4-4¼	1⅜-1½	2300
1	4¼-4½	1⅜-1¾	2400
1¼	5½-6	2⅛	2500

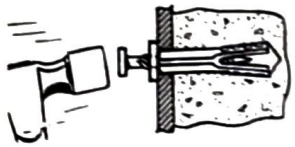
Shield Dia. (Inches)	Shield Length (Inches)	Working Load (Pounds)
3/16	7/8	375
	1¼	110
¼	1	200
	1¼	240
	1½	325
5/16	1¼	300
	1¾	350
	2¼	375
	2¾	375
⅜	2	450
	3¼	485
½	2¼	525
	3½	625

Drill indicated hole (in weak or soft masonry, go deep enough to set anchor just below surface); push anchor into hole, nut first, then "calk" with special tool. Pass screw through fixture and tighten into nut.



Insert shield in snug, press-fit hole, its top flush with surface. Pass bolt through fixture's mounting hole and turn into shield. As bolt is tightened, it draws nut (usually wedge-shaped) forward, expanding split sleeve.

Drill hole same dia. as shield, insert anchor through fixture's mounting hole and into wall. When flange is seated firm against fixture, drive nail home with a couple blows.



Heavy jobs such as construction (anchoring coal-bin wall stud—or floor plate to foundation when adding room).

For any heavy fixture to be bolted fast—cabinets, hanging shelves, ducts, hand rails—on solid masonry. *Some brands come in Short or Long sizes in same dia.; use long size for softer masonry.

Light, dead loads: furring strips, pipe, metal window frames, downspouts, outlet boxes — to concrete block, brick, mortar, stone.

Sleeve is precision-cast lead alloy—soft enough to press itself into the rough sides of the hole, but hard enough to give great holding power. Hard-alloy nut-cone prevents thread-stripping. Cannot be installed incorrectly; the heavier the load the stronger the grip.

Sure, heavy-duty anchorage; shields are tough, rustproof alloy casting. Wide choice of types, including closed-end (to protect threads from drill dust) and double-expansion types (with wedge-nut at both ends) for heaviest loads.

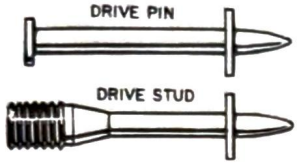
Fast — small hole means quicker drilling—and economical. Choose aluminum type for outdoor jobs, spiral-nail type for vibrating loads.

Though free calking tool is included in each *box* of anchors, you must buy one separately if you need less than a box (50 or 100 anchors), and you need a different tool for each size anchor. Length of screw critical.

Large, deep hole and wrench-tightening mean slower installation, and shields are relatively expensive, so use only where strong anchor is needed. Can loosen under vibration, so for that type of load, choose type that can be retightened.

Limited holding power; fixture can't be removed once nail is set. Mounting hole must be large enough to pass shield. Except for one type with spiral nail, poor resistance to vibration or jarring.

MASONRY (CONCLUDED)



SIZE RANGE

Not completely standard from brand to brand, but pin shanks range in dia. from ⅛" (in shorter lengths) to 3/16" and include following lengths: ½, ¾, 1, 1¼, 1½, 2, 2½, 3". Studs are available in some brands in 8-32, 10-24 and ¼"-20 threads in overall lengths of 1⅜, 1⅝ and 2".

INSTALLATION

Choose length to let pin penetrate ½-1" in concrete, ¾-1¼" in masonry block or mortar joint. (If pin bends, try next shorter length.) Pull drive rod out, press pin into anvil end, tap protruding point to seat pin in anvil, set point on installation spot and drive pin home with 2 or 3 lb. hammer. Washer holds fastener in tool, then slips up shank to provide support at point and keep material from pulling away between blows.

RECOMMENDED USES

Fastening pipe straps, brackets, junction boxes, mail boxes, furring strips, 2x4s or plywood, to concrete or masonry block.

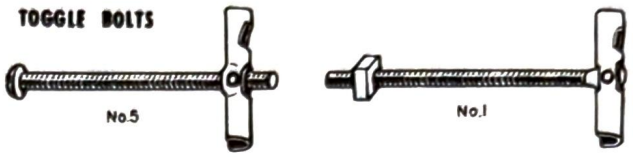
ADVANTAGES

Eliminates all drilling, making for quickest possible masonry anchoring. Each fastener specially heat-treated for extreme hardness. Studs permit removal of fixture.

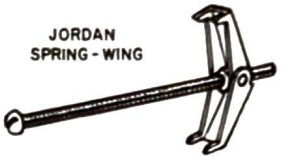
DISADVANTAGES

All fasteners must be installed with drive tool (retailing from $2.50 up, depending on make), can be used only in good-quality concrete (not usually recommended for brittle materials like stone, brick or tile), are limited to relatively thin fixtures (brackets, furring) where a number of fasteners can be driven.

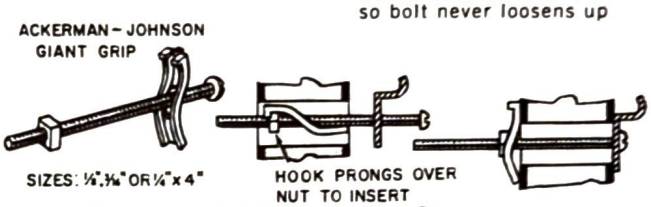
VARIATIONS AND IMPROVEMENTS

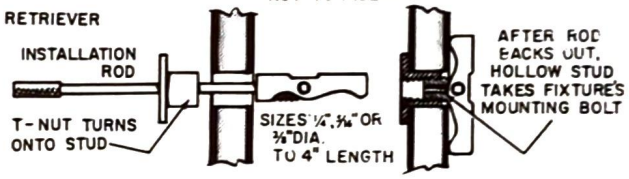


Not all standard types have spring-loaded wings. Gravity types shown above have "tumble" heads, pivoted off-center, creating strong, one-piece bearing bar. No. 5 is otherwise identical to a spring-wing, but type No. 1 has head riveted directly to stud

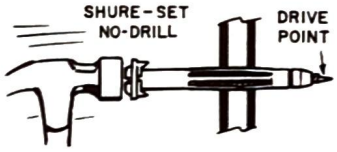


Recent innovations in toggle design include spring-wing with teeth (left) that bite into back of wall to keep nut positioned so bolt can be removed and replaced. Simplified tumbler, below, is lowest-price toggle, with S-head in constant tension so bolt never loosens up



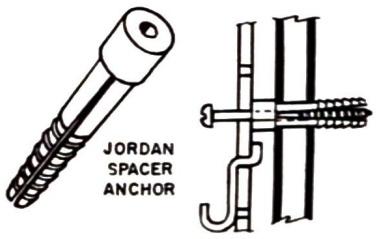

RETRIEVER
INSTALLATION ROD
T-NUT TURNS ONTO STUD
SIZES ¼",⅜" OR ½" DIA. TO 4" LENGTH
AFTER ROD BACKS OUT, HOLLOW STUD TAKES FIXTURE'S MOUNTING BOLT

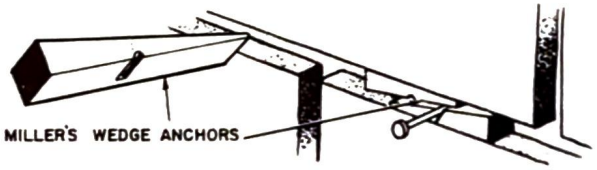
As name implies, here's a toggle that stays locked in wall like an expansion anchor when fixture is removed, yet can be retrieved for reuse by reinserting installation rod. Rod makes long bolt unnecessary. Also comes with longer stud to project from wall for nut



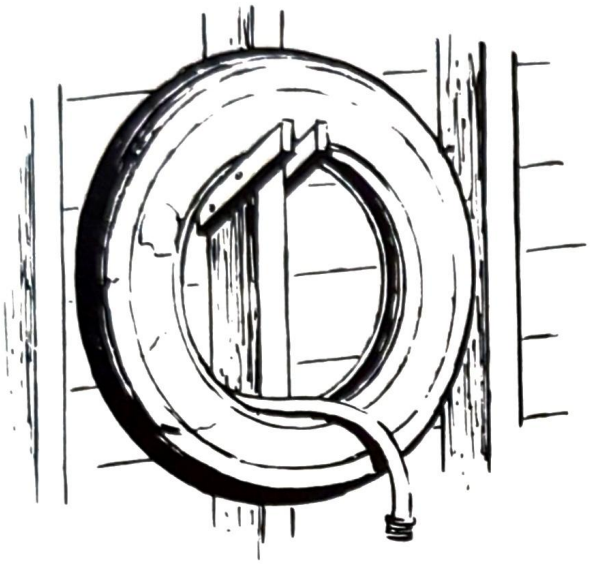
Pointed expansion anchor eliminates drilling step. Just drive it through wall till flange teeth embed, then turn screw to expand sleeve as with standard type. Ideal for softboard, other drywall

New addition to plastic anchor line has ⅜-in.-thick flange for mounting perforated storage panels. When shoulder seats against wall, flange automatically—without separate spacers—creates proper clearance for insertion of hanging hooks

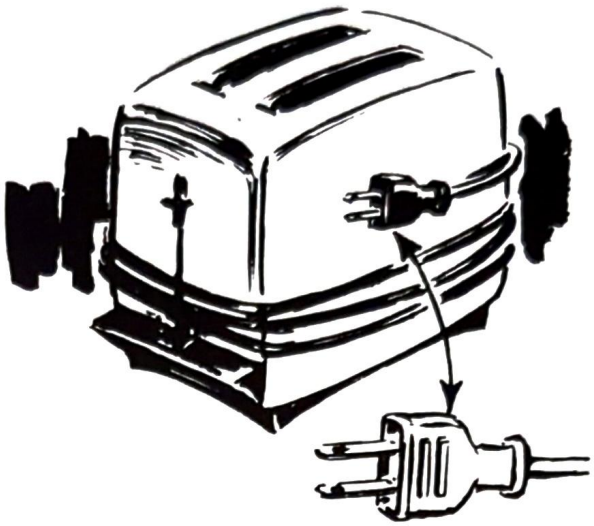




For any laid masonry with recessed mortar lines. Two (or more) lead tapers are wedged between bricks or stones, nail driven into best edge-notch for positioning fixture. No damage to masonry, and anchors can be removed without a trace by withdrawing nail



An old tire casing makes a hose holder that can be rolled easily from place to place. It's a real space-saver for off-season storage, since an 8:00 x 14 tire will hold as much as 75 ft. of hose.



Appliance cords are usually stored by coiling them around the appliance and twisting the plug under the last coil to hold it tight. An easier way is to cement a pair of magnets from a magnetic catch to the plug. These will hold it flat against the metal.

This scratching wall for your cat will save the drapes and furniture. Just mount a piece of carpeting on the end of a kitchen counter and train the cat to restrict his scratching to that spot.

If you bend the handle of a medicine spoon so that it sits level, you'll be able to put the spoon down while you replace the stopper in the bottle or pick up the baby to give him his medicine.

How to replace faucet washers

BY W. CLYDE LAMMEY

YOU WOULD BE surprised at the amount of water a leaky faucet can waste in a matter of hours—not days or months.

The faucet may be leaking at the packing nut or the washer may be so badly worn that it leaks even though you turn the handle off quite tightly.

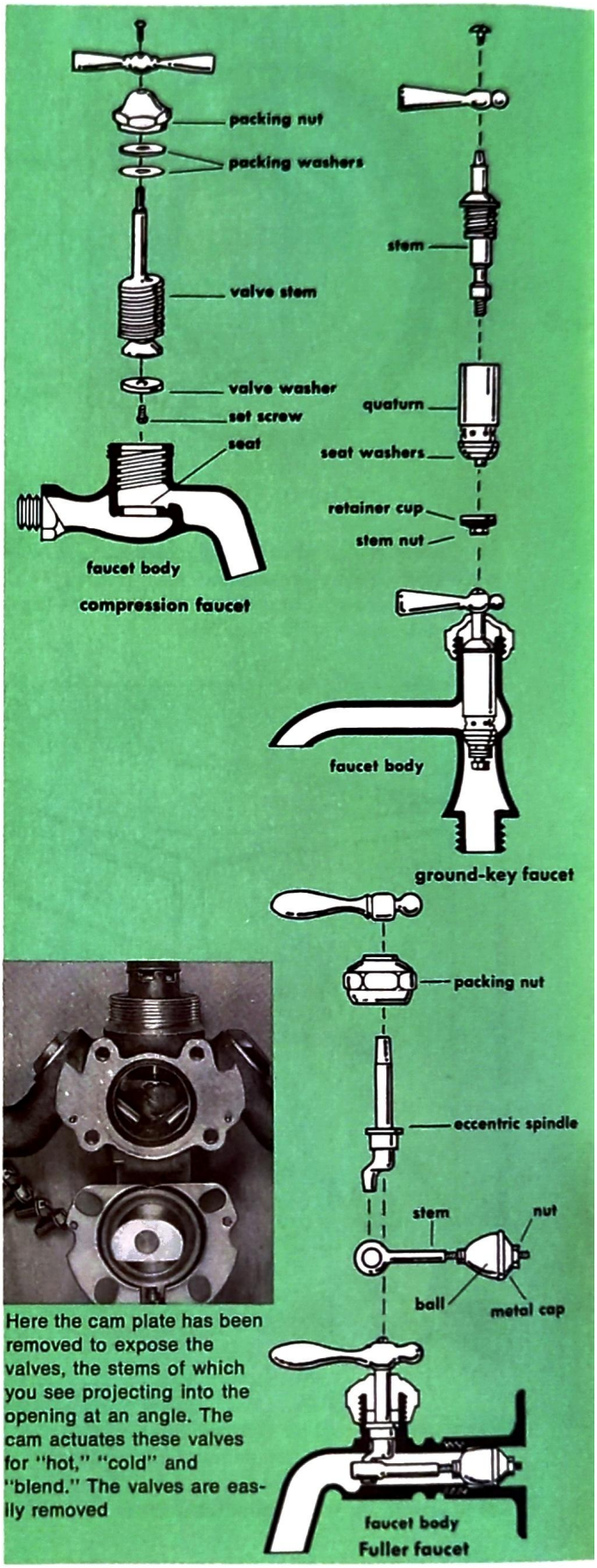
Most existing faucets, either kitchen-sink, lavatory or bathtub, are of the compression type, but in some installations you may still find the older Fuller-ball type.

First you close the valve at the meter. Then, if you use a pipe wrench, pad the jaws with thin blocks of wood, or felt, anything that will prevent nicking the plated parts. Loosen the packing nut, turn it off by hand and unscrew the spindle by turning the faucet handle to the left.

With the "works" exposed, loosen the brass screw at the lower end of the spindle and pry out the worn washer. Replace with a new washer of the correct size—it should fit snugly in the recessed seat—then replace and tighten the brass screw. Examine the packing. It will likely be a soft material, graphite-impregnated and shaped like a thick washer. If it's worn, torn or otherwise damaged, remove the faucet handle, slide the packing nut off the spindle, remove the old packing, replace with new, then replace the packing nut and handle.

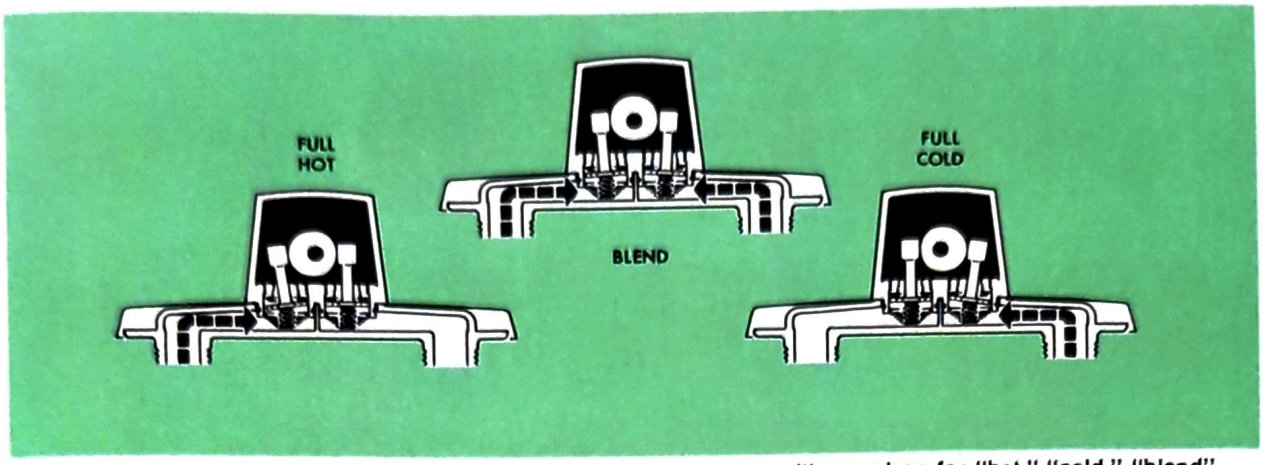
Reassemble the parts in reverse order, making sure the packing nut is tight. Close the faucet and turn on the water at the meter.

To replace the ball in the older Fuller-ball faucet, turn off the water at the meter, unscrew



Here the cam plate has been removed to expose the valves, the stems of which you see projecting into the opening at an angle. The cam actuates these valves for "hot," "cold" and "blend." The valves are easily removed

federal land: see home sites
feeders, bird: see bird feeders; game-bird feeders
feeder, dog: see boy's projects
felling trees: see tree felling
fence pickets: see tapers



Sectional views of a tip-valve, single-lever faucet show how the cam positions valves for "hot," "cold," "blend"

the packing nut and lift out the eccentric spindle. Then unscrew the faucet from the pipe, tap it lightly and out comes the ball with its stem. Replace the ball with a new one and reinsert in the faucet body, making sure the eye in the stem is located so the offset end of the eccentric will engage it when you tighten the packing nut. Then coat the pipe threads with thread compound, turn the faucet back onto the pipe and tighten.

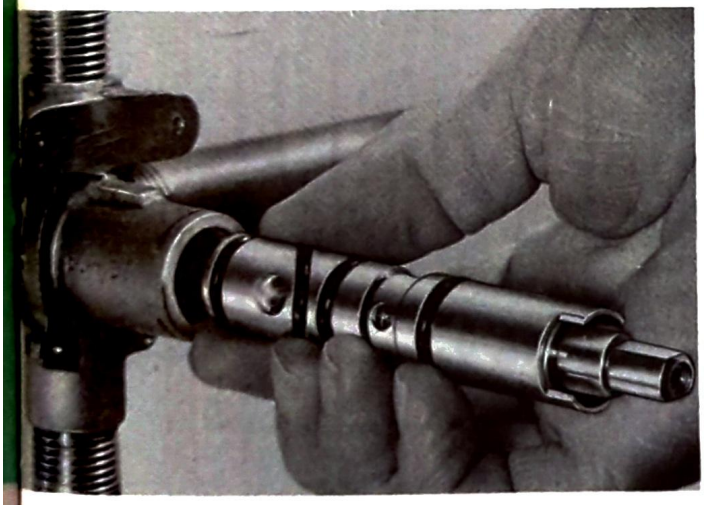
The ground-key, or ground-spindle, type of faucet is very nearly leakproof. Sometimes the nut at the lower end of the tapered spindle works loose, causing a leak. Tightening the nut or replacing the nut and retainer usually stops the leak.

There are several types of single-lever faucets, but what are generally known as the tip-valve and sliding-port types are perhaps the most common. None has washers. In the tip-valve faucet a cam actuated by the single lever tips, or tilts, the valves to the "full-cold," "full-hot" and "temperature-blend" positions. The sliding-port type accomplishes the same temperature variations by means of a simple stainless-steel sleeve actuated by the lever to bring openings into register.

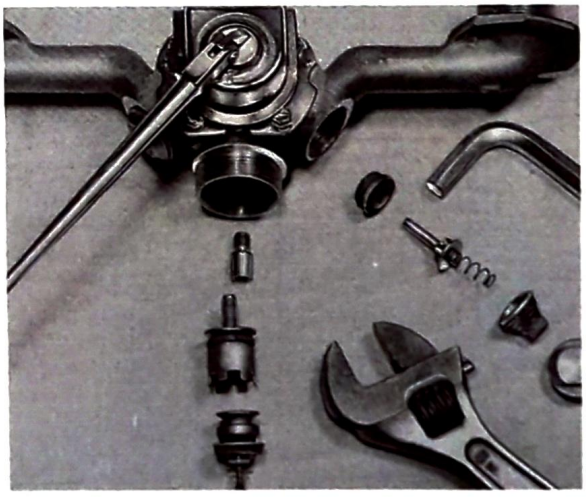
These faucets are more nearly trouble-proof than most other types. When they do go wrong due to long wear or other cause you simply replace either the valves or sleeve as the case may be. Replacements are relatively inexpensive. Once you remove the plated cover, or housing, it will be readily apparent what type of faucet you have and what to remove in order to make the necessary replacements. Just be extra careful with the wrench so that you do not damage brass screws, plugs, or caps.

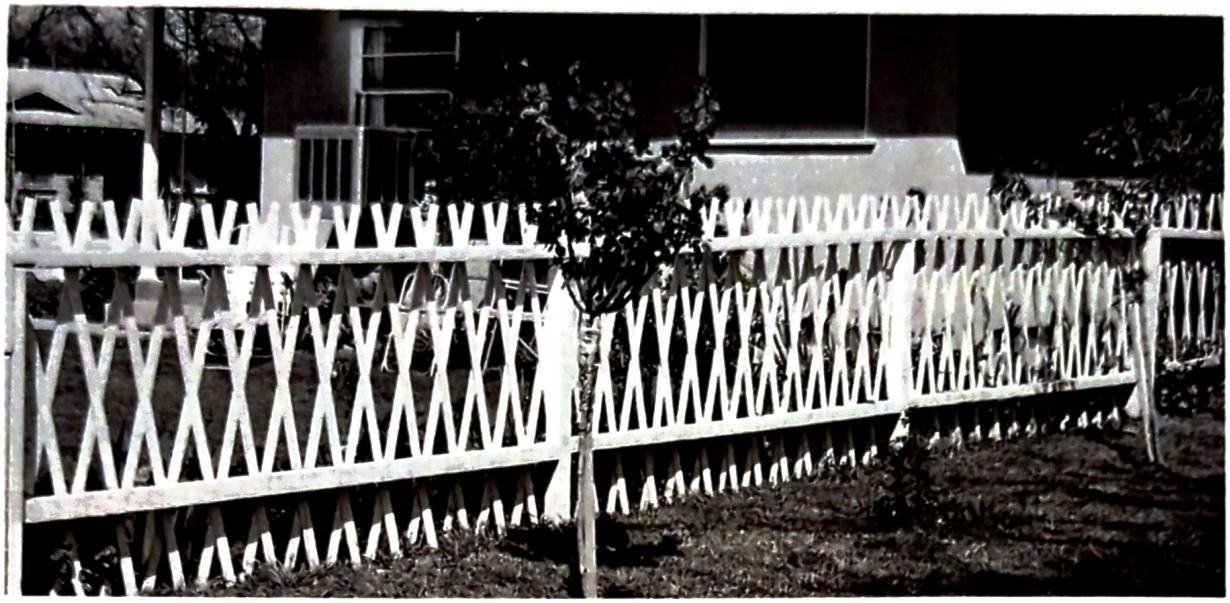
See also: bathrooms; drains; kitchens; plumbing; septic systems.

This single-lever faucet has a sliding port. Moving the lever brings openings into register to give hot, cold or warm water in any degree desired



Diverter valve for spray-rinse is shown in three parts at left of adjustable wrench. One tip valve is shown disassembled. See also photo on opposite page





A fence design to suit your fancy

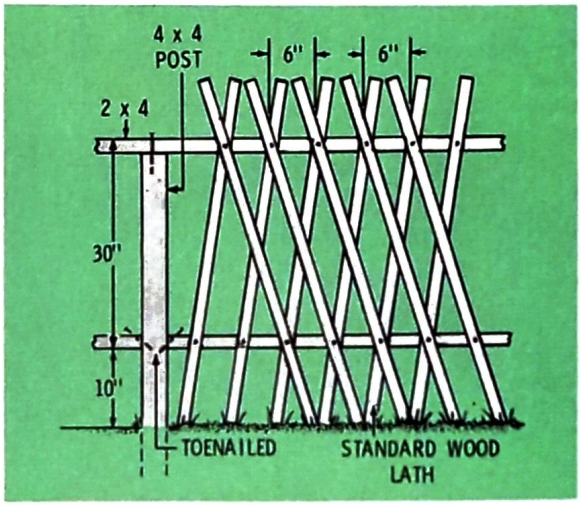
Have you been putting off
building that much needed
property-line fence
or privacy screen in your yard because
hackneyed designs leave you cold?
Then one of the 14 fences on these
four pages should inspire you to action

■ POET ROBERT FROST claimed "good fences make good neighbors." But your fence needn't look just like your neighbor's. It should be designed to do the job you want—whether it's to protect and dress up your property or to create privacy.

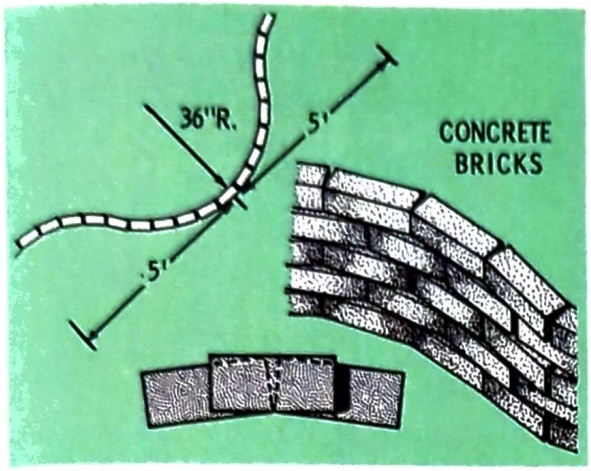
With today's great variety of materials to choose from, it's surprising that only a few homeowners venture beyond standard designs.

These four pages give you examples of the "personalized" flair you can achieve when building a fence on your property. And the styles pictured here won't hurt your pocketbook.

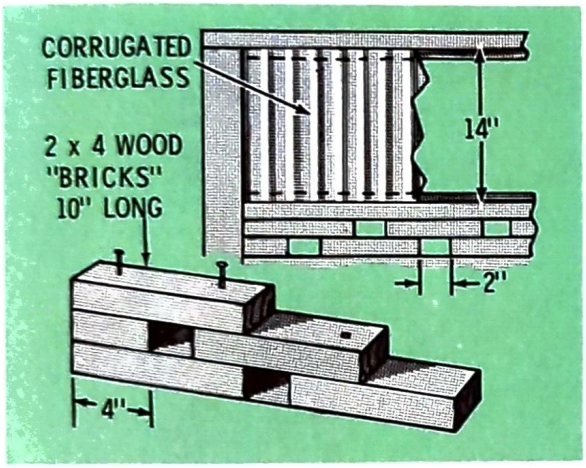
See also: brickwork; landscaping; patios; patio screens; retaining walls; tapers; walls, patio.



Even a white picket fence takes on a new personality if you use crisscrossed lath instead of conventional pointed stakes. It's less expensive and creates a stronger pattern (see photo above)



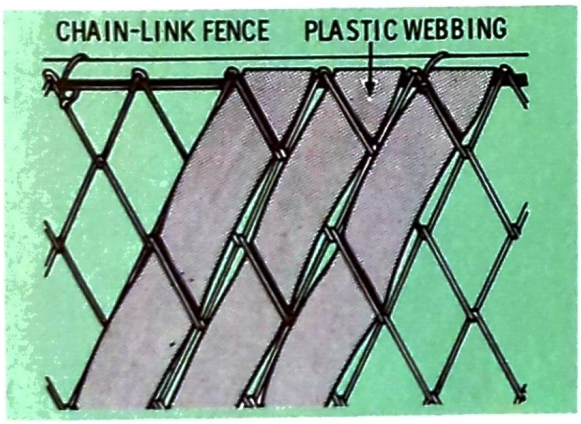
A serpentine brick wall isn't as tricky as it looks, once you lay out the concrete footing on the radii shown. Passersby may laugh at your drunken trench, but once you've laid a course or two, with generous amounts of mortar to fill gaps between the bricks, the wall begins to make sense. The curves reinforce the masonry, making it possible to erect one row

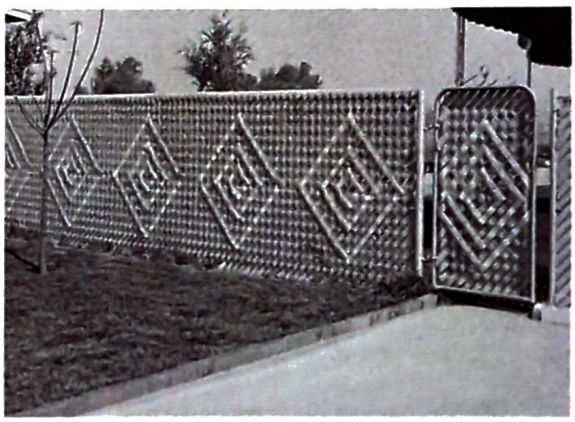


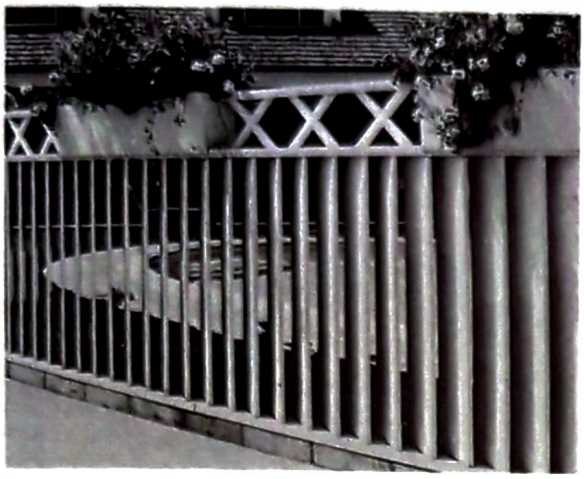
If you have scrap 2 x 4s, cut them into 10-in. blocks and start lapping and nailing with 8d or 10d nails—one per joint. The job goes fast, and gives you a fence that lets breezes pass through. If you run short of 2 x 4s, cap the stack with a full-length plate and finish with framed corrugated panels. Toenail every few courses of block into 4 x 4 end posts

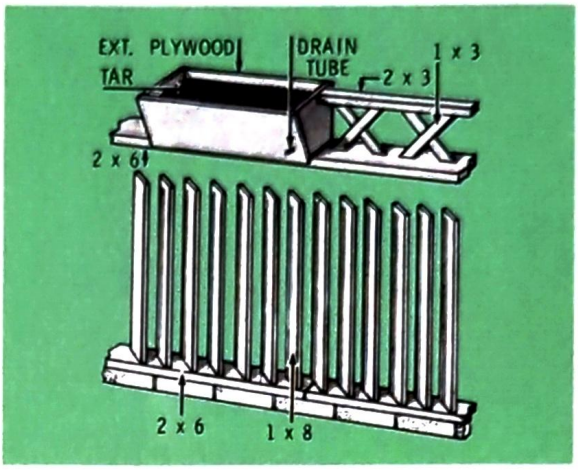
turn the page

Basket-weaving plastic strips through a chain-link fence adds privacy and offers bold possibilities for decorative effects in contrasting colors. This fence uses venetian blind materials, but 2-in. plastic webbing (made for lawn furniture) is available in many colors. You may have to anchor the top of each strip to achieve a neat effect

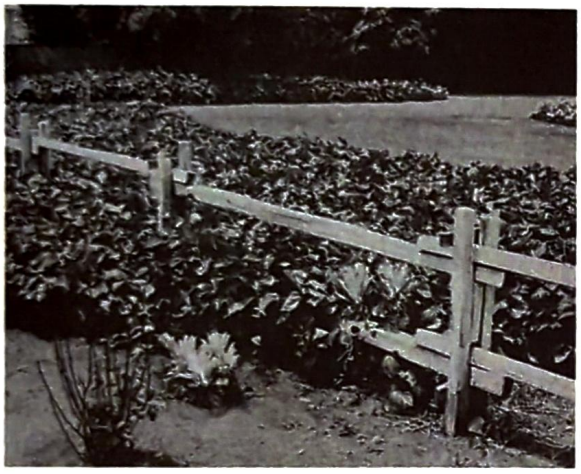






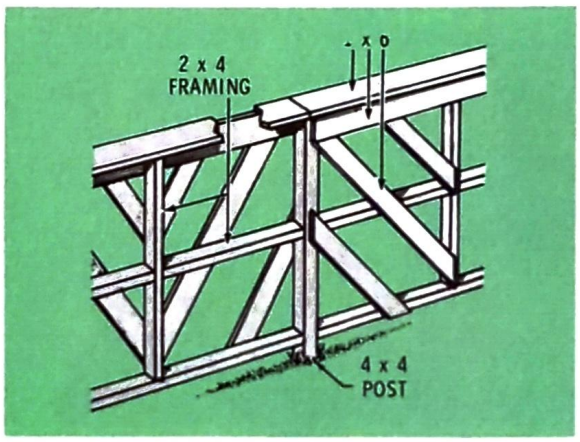


Breeze control for a pool or patio is a feature of the louvered fence. On-ground assembly is easy, with Ponderosa pine louvers laid one at a time between rails on two tapered blocks to establish a uniform angle. The blocks are moved to the next position after each louver is nailed through both rails. Base rail can rest on a running brick footing

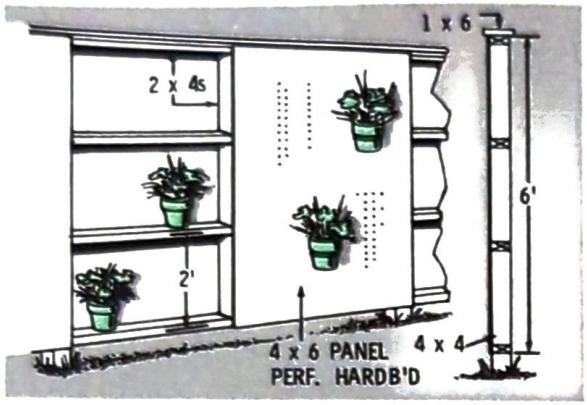


Familiar materials may be the most appropriate; such fences virtually design themselves. A split-rail type is fine in a spacious, informal setting with high ground-cover; redwood is best, but old telephone poles can be split. Cast-cement block in filigree pattern is laid on poured footing, like solid units, and creates a sturdy architectural grille

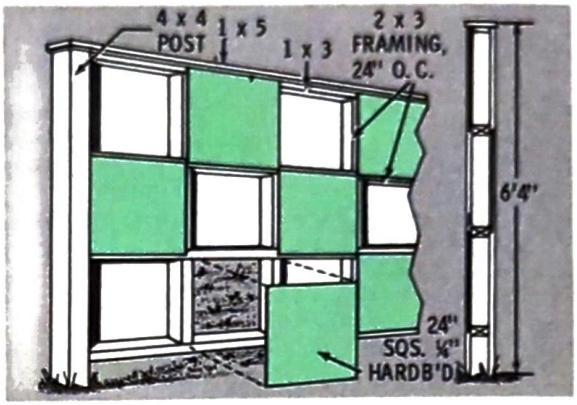
A herringbone rail fence is attractive from both sides. Divide run into equal between-post units to determine pattern. Cut three Ponderosa-pine rails to set at desired angle, use these as patterns. The fence looks best "growing" out of border planting but needn't be anchored to masonry piers, as shown here, if the alternate verticals are sturdy 4 x 4 posts



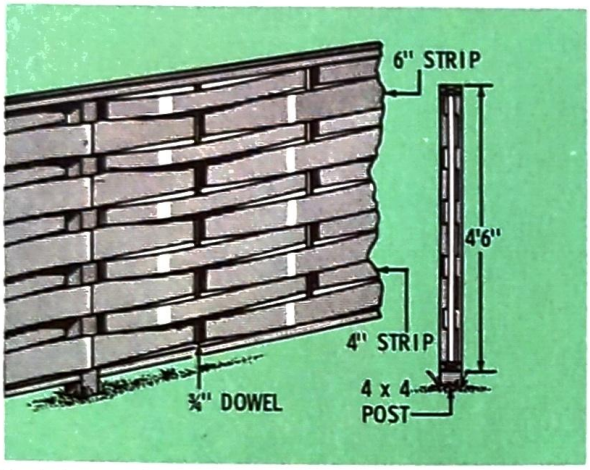
TRY ONE OF THESE SIX MODERN DESIGNS MADE FROM HARDBOARD



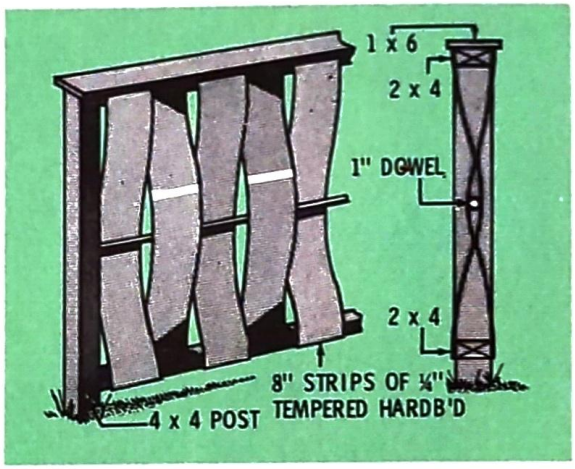
A hanging garden is yours when you erect a frame fence with alternate panels of heavy-duty perforated and plain hardboard on opposite sides. Perforations let you spot hangers



A checkerboard fence plays off painted squares against "shadowbox" backs of panels on the opposite side. By nailing 2-ft. squares on 2-ft.-on-center frame, you create a rabbet effect

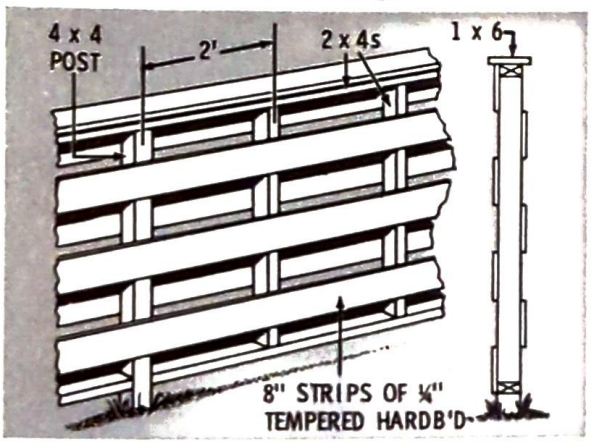


Basketweave is a familiar design, but it takes on added interest when alternate strips of hardboard are contrasting widths—and maybe two colors as well. Dowels can be painted to match or contrast

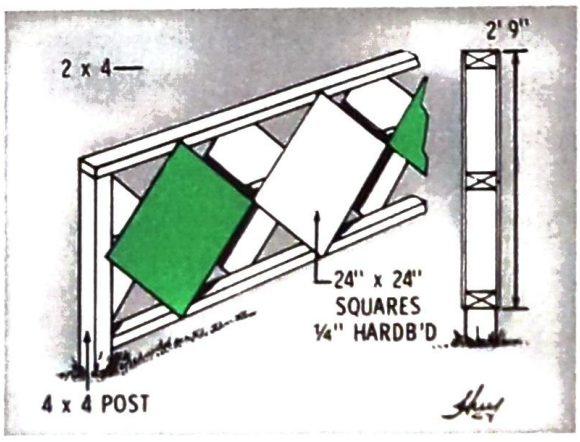


Vertical weave is a novel variation and one of the simplest to construct. Erect frame, nail dowel (or railing stock for wider sections) between posts, and feed strips in place, nailing top and bottom edge

Windbreak lets a breeze filter through without loss of privacy for a pool or patio. Strong lines of hardboard strips (nailed on alternate sides of the posts) complement horizontal house sidings

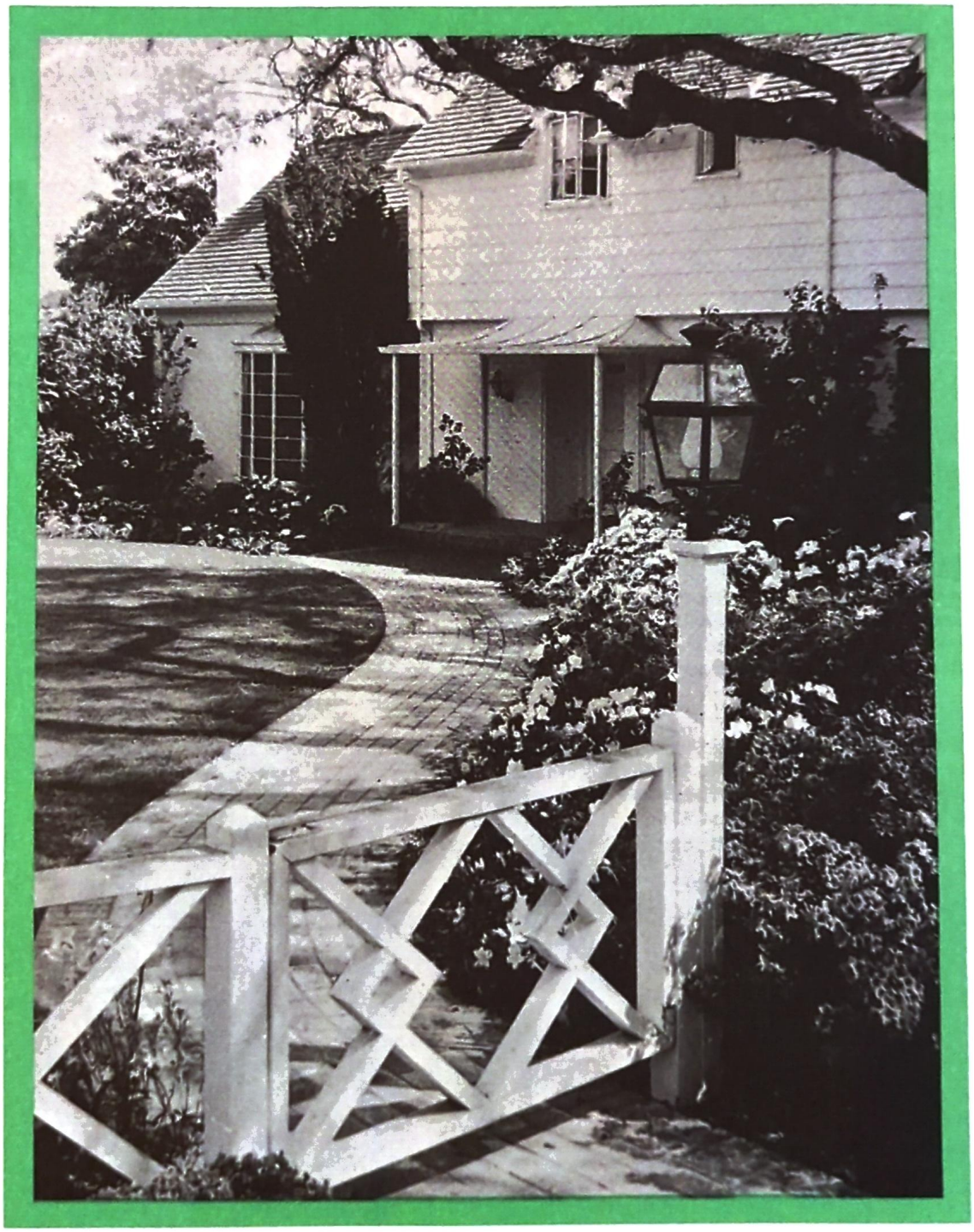


Harlequin diamonds make a festive low fence for the back yard or patio. Alternate squares are contrasting colors, and backs of squares on opposite side are left natural brown or painted a third color



Choose one of these six attractive fence styles
and build it yourself with only a few common tools

All about building fences



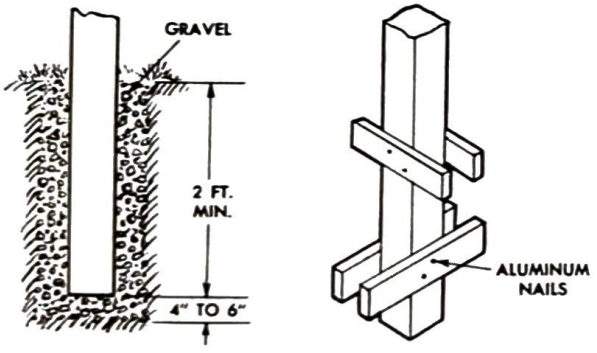
A FENCE has a place in modern living. It can form the walls of your outdoor living room. It can assure you privacy, guide a breeze across your patio or serve as a windbreak. It can accent architectural lines of your home, curtain unwanted views, frame a landscape, or form a backdrop for flower plantings.

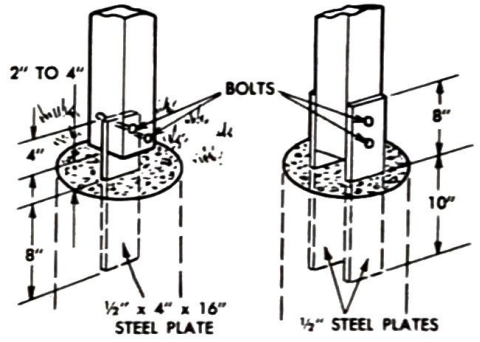
Fencing is permanent and must be built of durable materials. Its design must fit the property and suit your requirements. Thus selection of materials and design requires a little forethought.

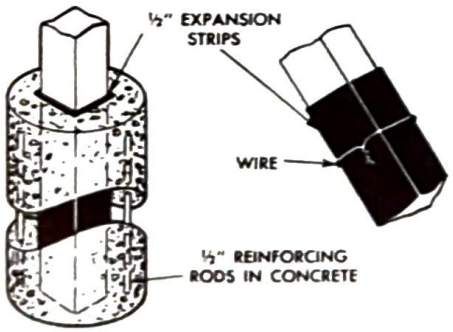
First, make sure you know where the property lines are located; then check your local codes governing the location and height of fences permitted in your community. Next, select woods that are resistant to decay such as cedar, redwood and cypress, and decide on the design.

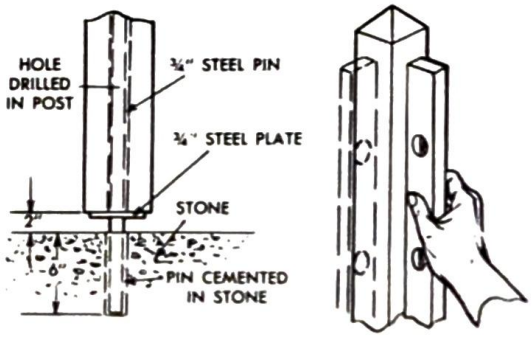
Details on this page show different methods of setting posts to give the necessary rigidity and prevent rapid deterioration of the wood. Setting in tamped gravel is perhaps the simplest and fastest way of anchoring posts in heavy clay soils.

In lighter soils posts should be set in concrete by one of the several methods detailed. Unless posts have been pressure-treated with creosote it's a good idea to coat the wood with a preserving chemical or soak that part below ground in creosote before setting. Take your choice of any of the several designs illustrated, and build the fence with careful attention to the simple details of construction. That's what makes a neat, workmanlike job that pleases the eye of a craftsman. See that the posts are lined up at the time of setting. Make sure before you cut stock to length

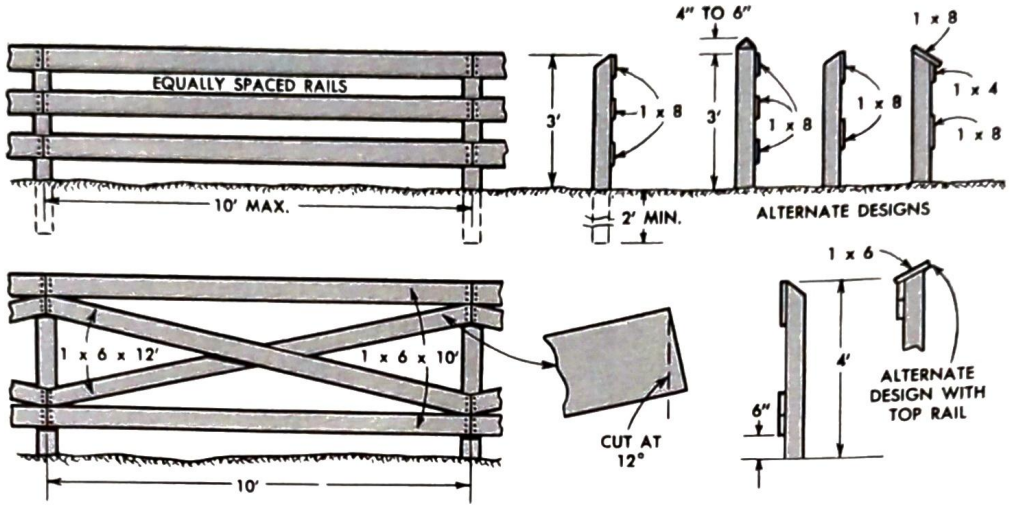




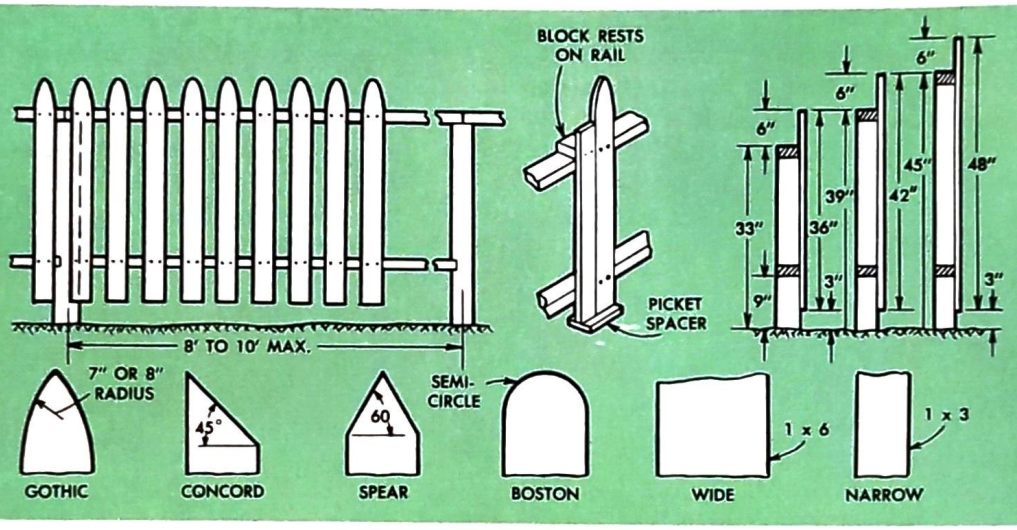




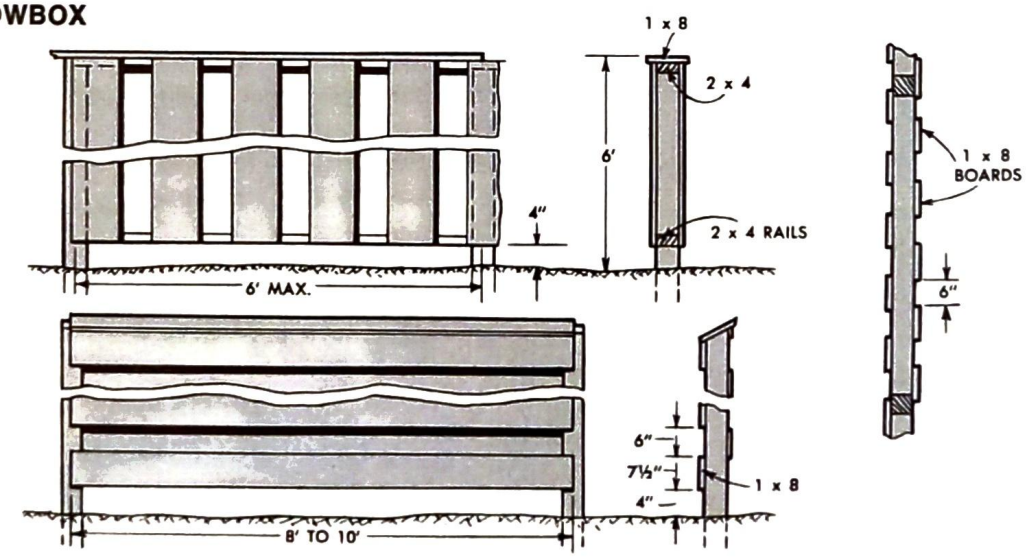
RAIL



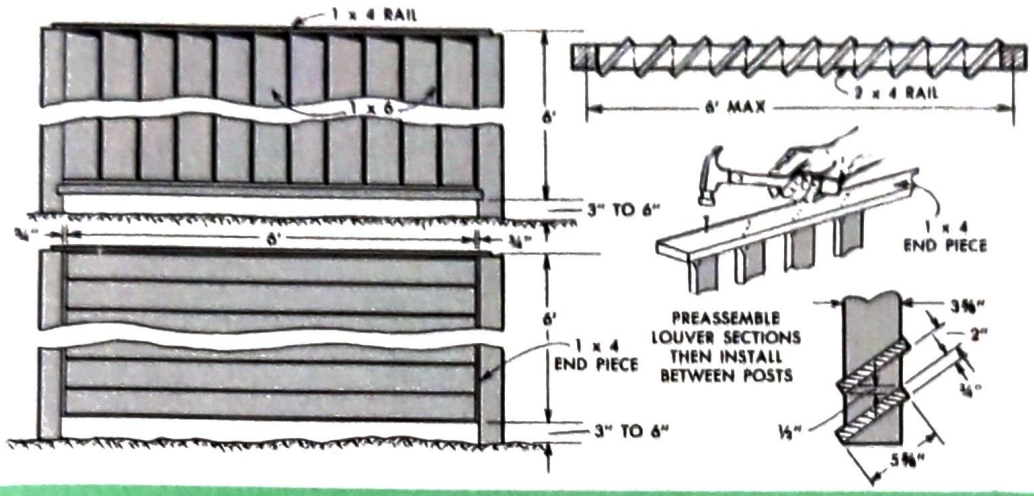
RUSTIC



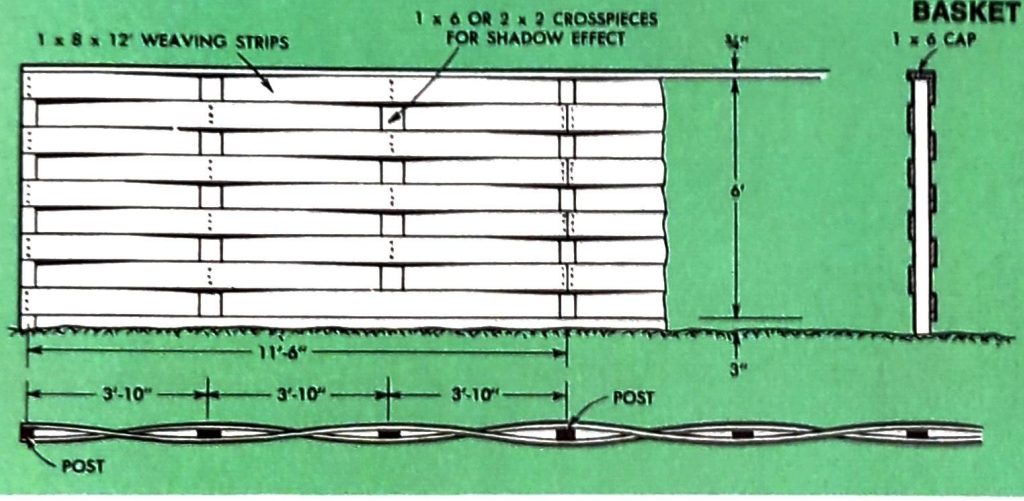
SHADOWBOX



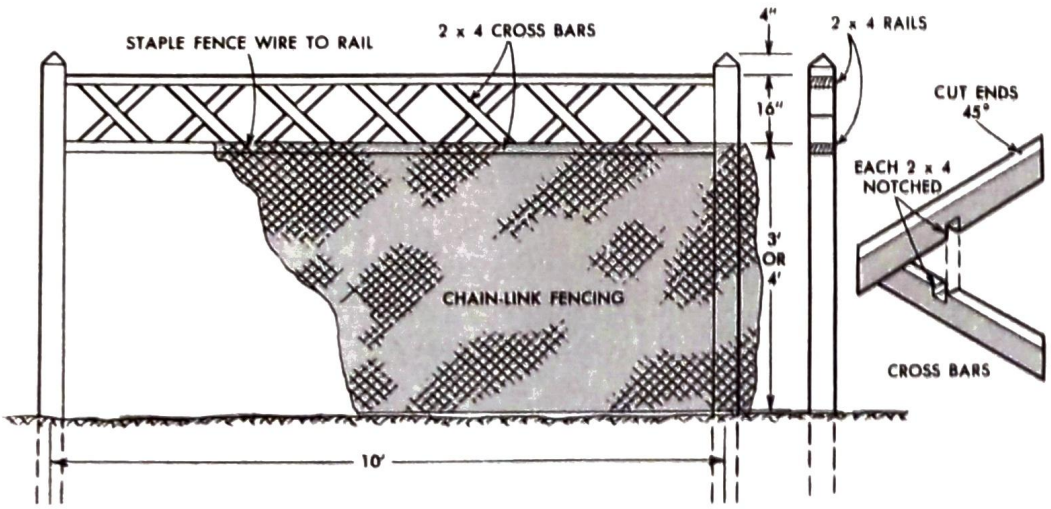
LOUVERED



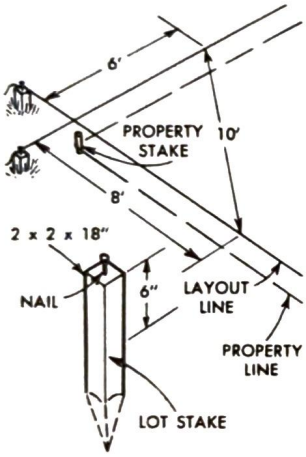
BASKET WEAVE



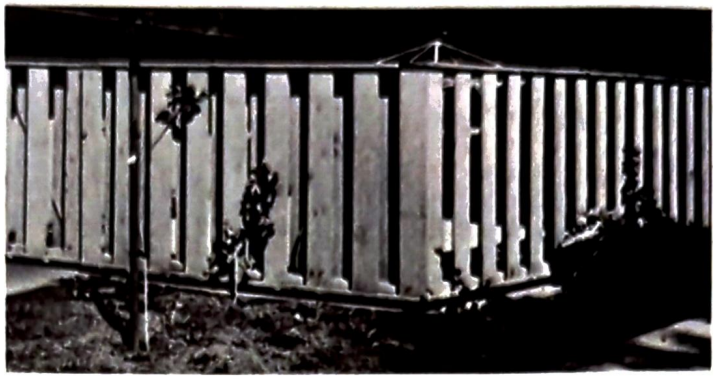
COMBINATION

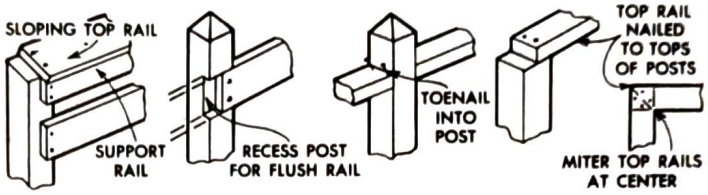


Soak untreated posts in creosote before setting. The treated portion of the post should extend at least 6 in. above the grade level when set



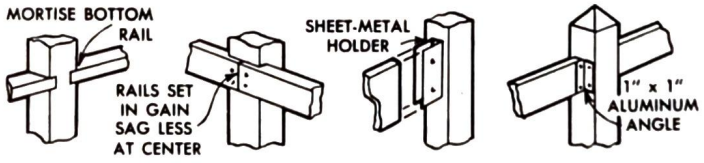
Ways of locating the fence and aligning the posts are detailed above and below. Careful attention to the simple details of construction makes a workmanlike job

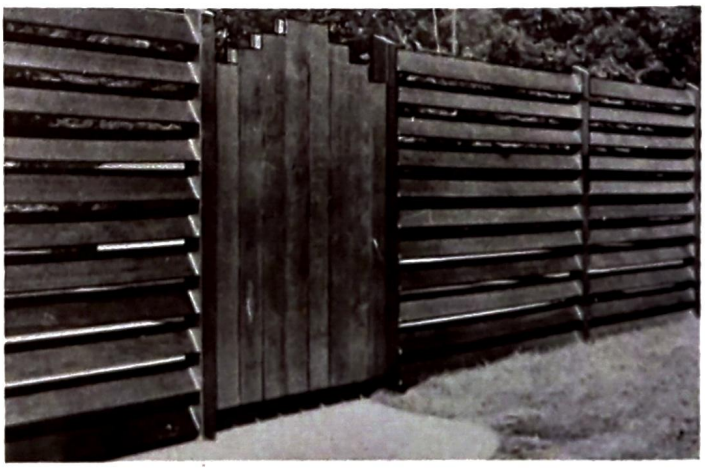



SLOPING TOP RAIL
SUPPORT RAIL
RECESS POST FOR FLUSH RAIL
TOENAIL INTO POST
TOP RAIL NAILED TO TOPS OF POSTS
MITER TOP RAILS AT CENTER

that you have the correct measurements. Keep the nails well back from the edges and ends of stock so that the wood doesn't split when the nail is driven home. A fence is exposed to all kinds of weather all year 'round so use aluminum nails for fastening.

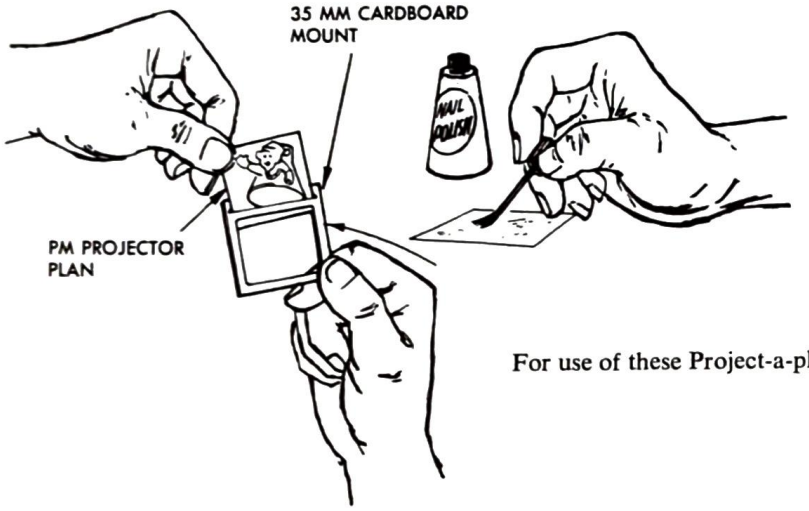
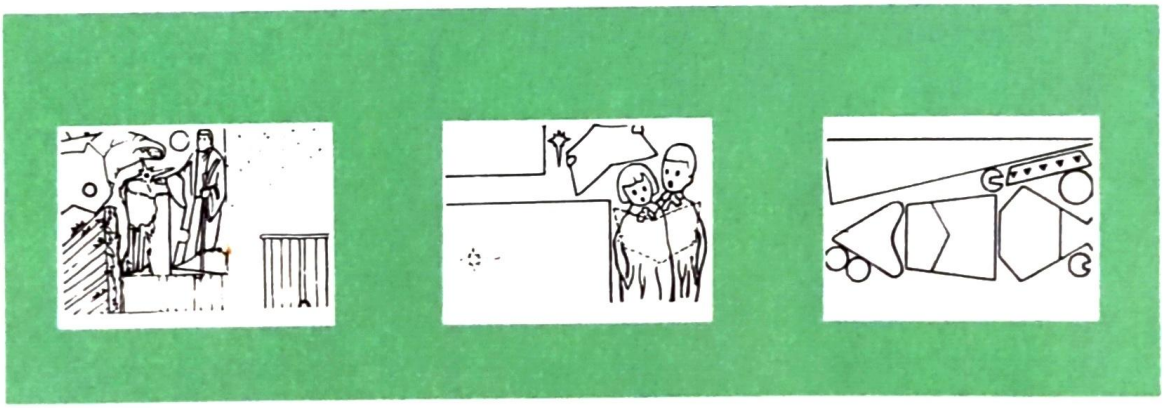
Of course the fences suggested here are just basic ideas. You will have to change the dimensions and designs to suit your particular needs. In fact, a fence can be a highly personal thing. Using the basic types of fences shown here as basic ideas, you can create a fence that will be entirely your own design.





Project-a-plan

If you haven't used Project-a-plan transparencies before, you're in for a real treat. They'll help you enlarge patterns the easy way. First you clip the one you want to enlarge right from this page. Next you rub the front and back with vegetable oil, or coat with shellac or clear nail polish to make the paper transparent. Finally, you insert your paper "film" in a regular 35-mm cardboard slide mount. You now have a black-and-white slide that can be used in any 35-mm slide projector. This slide permits you to blow up the pattern to any size you wish. Stand the material that you intend to cut the pattern from—such as hardboard or plywood—against the wall like a movie screen. Project the plan on it, determining size by moving the projector closer to or farther away from the screen. Be certain that the projector is at right angles to the work. Now simply trace off the projected outlines right on your material and you're ready to start cutting.



For use of these Project-a-plans, see page 796.